U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU.

BULLETIN No. 8.

# REPORT

ON THE

# CLIMATOLOGY OF THE COTTON PLANT.

BY

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# LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Weather Bureau,
*Washington, D. C., December* 15, 1892.

Sir: I have the honor to transmit herewith a report on the "Climatology of the Cotton Plant," by Prof. P. H. Mell, of the Alabama Polytechnic Institute, and to recommend its publication as Weather Bureau Bulletin No. 8.

Very respectfully,

Mark W. Harrington,
*Chief of Weather Bureau.*

Hon. J. M. Rusk,
*Secretary of Agriculture.*

# LETTER OF SUBMITTAL.

ALABAMA POLYTECHNIC INSTITUTE,
*Auburn, Ala., August* 9, 1892.

SIR: I have the honor to submit herewith a report on the "Climatology of the Cotton Plant," prepared at your request.

Very respectfully,

P. H. MELL,
*Professor of Geology and Botany.*

MARK W. HARRINGTON,
*Chief of Weather Bureau.*

# TABLE OF CONTENTS.

TABLES—Continued.



CHARTS—

# CLIMATOLOGY OF THE COTTON PLANT.

## INTRODUCTION.

The botanical question relating to the cultivation of cotton has been one of great interest to the writer for a number of years, and he entered upon the study of the climatology of the subject with more than an ordinary degree of pleasure. As the work developed, however, it became more and more apparent that limited time and the vast array of meteorological data would prevent anything more than simply an introduction to the study of cotton and its climate.

It is proper to say that in the collection of the data for the writing of this pamphlet liberal use has been made of numerous United States Government reports and publications, the files of the "Commercial and Financial Chronicle," many agricultural papers and magazines, and books relating to the cultivation of cotton in the United States and in foreign countries. Valuable advice and counsel have also been rendered by Dr. J. T. Anderson, assistant state chemist of Alabama, and valuable assistance in the preparation of meteorological data.

The following planters and meteorological observers and scientists have also furnished useful information: From Virginia, J. N. Ryker, assistant director State Weather Service, R. V. Gaeves; from South Carolina, W. J. Hinson, E. R. McIver, Dr. A. P. Battle, director State Weather Service, J. A. Peterkin; from Georgia, J. K. Dixon, H. W. Blount, Col. R. J. Redding, director Agricultural Experiment Station, J. A. Law, S. E. Lewis, J. A. Chapman, D. M. Wade, R. L. Rhodes, J. F. Wilson, Park Morrill, director State Weather Service, S. M. Barnett, J. L. Cutler, S. A. Cook; from Florida, Livingston Vann, E. R. Demain, director State Weather Service, H. W. Long, Dr. J. P. DePass, director Agricultural Station; from Mississippi, R. J. Hyatt, W. E. Butler; from Louisiana, D. N. Harris, L. J. Dodge, W. W. Wall, Dr. W. M. Guice, Dr. E. A. Crawford, G. E. Hunt, director State Weather Service, Prof. W. C. Stubbs, director Agricultural Station, G. W. Whitworth, L. D. Martin, A. F. Thanpeau, M. J. Wright, jr.; from Tennessee, G. W. Lasater, Prof. C. F. Vanderford, assistant director Agricultural Experiment Station, J. B. Marbury, director State Weather Service, C. W. Anderson; from Texas, Prof. Duncan Adriance, meteorologist Agricultural Experiment Station; from Arkansas, R. L. Bennett, director Agricultural Experiment Station, E.

H. Clarke, assistant director State Weather Service; from Missouri, J. H. Smith, assistant director State Weather Service.

## I.—HISTORY OF THE COTTON PLANT AND ITS SPECIES.

The cotton belongs to a large family of plants called Malvaceæ, and is represented by more than fifty species. Only about six or eight of these species, however, are of special commercial value, and from these the fiber of the world is produced. Among this number may be mentioned the following as representing the most important:

1. *Gossypium bahma*, or Egyptian cotton.

2. *Gossypium barbadense*, also called *Gossypium nigrum*, sea-island cotton, long-staple cotton, and black-seed cotton.

3. *Gossypium herbaceum*, also called *Gossypium album*, short-staple cotton, upland cotton, and green-seed cotton.

These species have been again divided into a large number of so-called varieties, that have been produced by accidental crossings between species exposed to each other in neighboring fields years ago, until now, under peculiar conditions of cultivation and changes of climate the specific characteristics have been largely concealed, and it is somewhat doubtful whether the upland cotton is *Gossypium herbaceum* or the mingling of several species.

*Gossypium bahma* originated in Egypt many years since, and was produced through an accidental hybrid from the *Hibiscus esculentus* with the native Egyptian cotton.

The *Gossypium barbadense*, or sea-island cotton, came originally from Persia, from which country it was transplanted to the Island of Anguilla, then to the Bahama Islands, and subsequently to the coasts of South Carolina and Georgia and East Florida. This plant has been grown with various degrees of success for many years on the islands of Edisto, Saint Simons, Jekyl, and Skidaway; but it has never reached that degree of development and extent of cultivation that has been accorded the upland cottons.

The *Gossypium herbaceum*, or green-seed cotton, is the name generally applied to all plants grown in the interior of the cotton belt, although I am inclined to the belief that an investigation will prove that the upland cotton is the blending of several species. It is quite difficult to give the exact origin of the *Gossypium herbaceum*, as many sources have been claimed for it. Some of the authorities have referred it to an offspring from the Brazilian cotton, while others with equal positiveness assert that it came from the Mexican stock, and hence have given it the common name of "Mexican cotton." There is every reason to believe, however, that the plant has long been acclimated to its present home, and, as already stated, has undergone many changes that have been brought about largely through climatic conditions. From its more or less shrubby form, it is supposed by some authorities

to have been tree-like in its early history and not an annual as it is now. In support of this idea it is well known that in some portions of the cotton belt the plant assumes sometimes almost the size of a tree and its stem becomes decidedly shrubby. Its habitat, however, over the entire South has reduced it to an annual, and the seed is planted and the fiber is matured between the last frost of spring and the first frost of autumn.

It is said by those who claim that the original plants came from Mexico, that in the early part of the present century the United States Minister then at the court of Mexico noticed this species of cotton growing in a comparatively wild state in that country, and whenever it was subjected to cultivation the resulting fiber was long, white, and beautiful. He requested permission of the Mexican Government to transport some of the seeds to his country for the purpose of experimenting with it to determine if it could be successfully grown in the United States. This request was refused. At a state dinner subsequently, however, the subject of cotton and its cultivation was introduced, and in the progress of the conversation the minister was informed that no objection would be raised to his exporting as many dolls to his country as he might desire. He immediately took the hint, and had a large number of dolls stuffed with the cotton seed and lint that he succeeded in securing from the most healthy and vigorous plants. These dolls were sent to Washington and the cotton seeds were distributed over the Southern States, and in years after became the cotton plant of the South. The accuracy of this incident is not vouched for, but it has received considerable credence in the southwestern portions of the cotton belt, and it is simply given as a matter of interest in this connection.

It is also stated by a few authorities that the *Gossypium herbaceum* came originally from the coasts bordering the Mediterranean and from portions of Asia Minor. From a speech delivered by W. B. Seabrook, president of the South Carolina Agricultural Society, in 1843, the following extracts are taken as interesting in connection with the discussion of the origin of the green-seed cotton:

As a preliminary point it may be asked whence came the seed of this cotton, now so extensively cultivated in the United States? This question is probably not susceptible of a positive and unexceptionable answer. That it was not brought from India is perhaps obvious. The policy of the East India Company, who obtained their monopoly in the year 1600, was unquestionably adverse to the exportation of cotton seed. Individuals would scarcely have deemed it necessary to draw from the distant East that which was obtainable much nearer home, and of a quality, too, greatly to be preferred. As the trade in the raw material, during the larger portion of the period alluded to, was confined to the Mediterranean, it was a legitimate inference, in the absence of positive proof, that from that quarter the nations of Europe owning possessions in the western hemisphere respectively introduced into them the new culture. This, perhaps, was especially true of the Low Countries and of England, as in 1560 the former constituted the depot for cotton goods from the Levant; and the Turkish trade, of which

Smyrna was the seat, was at the time of which we speak the most important to the latter. Peter Purry is represented to have brought with him, among other seeds, that of cotton [Peter Purry settled in South Carolina in 1731, during the administration of Governor Robert Johnson.] This, and a paper of the same material received by the Trustees for the settlement of Georgia, from Phillip Miller, of Chelsea, England, it can be scarcely questioned, were from the Mediterranean. In a pamphlet entitled "American Husbandry," published in London in 1775, the writer remarks that "the cotton cultivated in our colonies is of the Turkish kind." On the other hand, it must be supposed from the language of their historian that the Cape Fear emigrants, who began the growing of the *gossypium* only two years after they had established their settlement, were provided with seeds from Barbadoes. The vicinity of the West Indies, the profitableness of the cotton crop, the varieties of the plant, which at an early period were cultivated in those islands, all render it nearly certain that from thence was drawn a portion of the supply with which the people from time to time were provided.

Between 1786 and 1795 cotton from various parts of the world was introduced into the Southern States and Louisiana. A species of the white Siam was for some time the subject of experiment by the French in the latter country. The "Nankeen" came from Malta. The "Bourbon" was brought from that island to Charleston through the instrumentality of James Hamilton, who was a merchant and part owner of the only India ship at that time trading beyond the Cape of Good Hope. The "Pernambuco" or "kidney cotton" was sent from Havana to Mr. Levett of Georgia, by a Mr. Welch, a merchant in Philadelphia. These, and many other sorts, after a fair trial, were abandoned, for the reason of their inferiority to the kinds then profitably raised, viz., the real green seed and the black seed or sea island cotton, the latter having superseded the plant that was grown at the period of the Revolution, which strongly resembled the short staple in growth and blossom, except having a clear black seed with fur at the end. From this brief notice of the quarters whence different cottons were received in this country we have satisfactory reasons for concluding, that to the Mediterranean and Asia Minor we are mainly indebted for the particular species of *gossypium* which has been the subject of investigation. Of the two kinds from which the green seed is derived, the *herbaceum* is clearly of Eastern origin, and the *hirsutum* also probably, though it is positively asserted to be a native of the West Indies.

From all the testimony presented on the subject of the origin of the present green seed cottons, from which nine-tenths of the staple of the South is obtained, it seems more than probable that this plant is the result of frequent hybridizing between various species of the *gossypium* through a long period of years. The peculiar soil of the South, together with its characteristic climate and the methods of cultivation universally used by the planters for more than one hundred years, have much to do with changing the plant to what is now known as *Gossypium herbaceum*. What the plant was when first introduced we can only conjecture; nor can it be positively asserted that it is not indigenous to the South. That it has undergone great changes within one hundred years there can be no doubt, as is well indicated by the large number of so-called varieties that have been brought before the farmers within the past thirty years. That climate has had much to do with this no one can deny.

Thirty or forty years after the first authentic cultivation of the green seed cotton, some farmers living in the State of Mississippi, near the Mississippi River, discovered that under peculiar methods

of cultivation the plant would thrive and produce a very superior grade of fiber. They also found that by carefully selecting the seeds from these special plants and planting them under the best conditions the quality of the fiber was greatly improved. This method gave rise to the first variety of the upland or green seed cotton that was named "Petit Gulf," after a little quiet bay formed by the Mississippi River in that State. The demand for that seed became great at once, enriching the farmers who first handled it, and encouraged other planters throughout the South to experiment, until now there are more than thirty so-called varieties known.

## THE EXTENT OF THE COTTON BELT.

At the opening of the war between the States in 1861, the cotton region of the United States included South Carolina, Georgia, and Florida north of latitude 27°, Alabama, Mississippi, Louisiana, southern portion of Tennessee, Arkansas south of latitude 35°, and Texas between the Gulf of Mexico and 34° north latitude. A small part of North Carolina might also be included in this area, but in this State the planting and cultivating of cotton was quite limited in 1858. Up to 1860 this belt was being gradually extended east, west, and north. In the east it had reached the coast of North Carolina and had extended westward as far as some of the southwestern counties on the Rio del Norte in Texas. The planting in Tennessee had not extended much beyond the middle of the State. The counties lying immediately around Memphis were generally considered to have the best soils for this purpose, and prior to 1860 produced the largest proportion of the cotton raised in Tennessee.

The line running across the United States a little north of the thirty-sixth parallel will about designate the northern limits of the cotton region at the close of 1860, and the southern limit about coincided with the twenty-ninth parallel (see Chart VII). After the close of the war, when the high price of cotton stimulated its cultivation, the farmers, not only throughout the belt already indicated, but planters beyond the northern limits, cultivated large areas and attempted to force the plant to perfect its fruit, by the use of fertilizers, before the occurrence of frosts. But all attempts to carry the cultivation of cotton much beyond the State of Tennessee have proved failures, and to-day the cotton belt is not materially extended beyond what it was in 1860.

Chart VII, copied from the Tenth Census, vol. 5, shows the extent of the cotton belt in 1882. The shading gives the varying intensity of cotton culture as compared with the total land area. In commenting on this map Dr. Hilgard, the special agent for the Census Bureau, says:

The regions of high percentage devoted to cotton (10 to 20 per cent. of the total area)

are confined almost exclusively to the central portions of Mississippi, Alabama, and Georgia. the cotton acreage averaging above 65 acres per square mile within the respective areas. Small patches (representing counties) of the same occur in North Carolina, Tennessee, and Texas.

Regions of maximum intensity of cotton culture above 20 per cent. of the total area form two prominent belts (shown by the deepest shades of color) one lying along the Mississippi River within the alluvial region, while the other embraces the black prairie region from northeastern Mississippi, southeastward nearly through the central portion of Alabama. The cotton acreage within these belts averages 130 acres per square mile, and upon them was produced in 1879 about 753,550 bales of cotton. A penumbral region of very sparse culture is seen almost to surround, both inland and along the coast, the cotton-producing portion of the States, while outlying areas (representing isolated counties) occur in Kentucky. Cotton culture in Florida is chiefly confined to that part of the State lying adjacent to Georgia. This is mostly pine land, and is cultivated without manure; hence the low product of less than a quarter of a bale per acre. No cotton is returned from that portion of the state lying south of Tampa Bay, and but little from the coasts, as well as from the extreme western part. A considerable proportion of this product is long-staple or sea-island cotton, of which the State produces nearly the entire supply at present. The cotton production of Tennessee is concentrated upon a comparatively small area of highly productive lands, the rest being devoted preferably to grain, grasses, tobacco, and other industries, to which the soils and climates are more specially adapted. A discussion of the returns shows that 52 per cent. of the cotton product of Texas is grown in the northeastern portion of the State, north of the thirty-second parallel and east of the ninety-eighth meridian, and that within this region the production is highest in the counties adjoining Red River, the product averaging 0.54 bale per acre. South of the thirty-second parallel the average yield is 0.34 bale per acre. The coast counties produce but little cotton; inland, between Red River and San Antonio, about 34 per cent. of the total product is grown on black prairie land.

In another part of the volume above mentioned, Dr. James M. Safford, in writing concerning Tennessee, says:

The latitude of Tennessee is such that a fall of two degrees of temperature in the northern part of the State might cause a killing frost, resulting in the destruction of the cotton plants, while the same fall in the southern part would leave them intact. The length of the growing season for cotton is, at the best, short enough in the southern part of the State, and where so slight a change of temperature produces such results we can readily see how in the northern part it may be generally too short for full crops, which in reality it is. It amounts nearly to the same thing to say that the margin of the cotton-growing section of the country runs through Tennessee. In an inspection of the map showing percentage of aggregate areas in cotton, as compared with the entire area of any given region, it is seen that the counties in Tennessee which plant and produce the most cotton are strikingly the most southerly ones, and that from these the production decreases almost uniformly as we go north. This is especially so in West Tennessee. Now, in explanation of this, in part, at least, it is to be noted that the isotherms, or lines of equal temperature, for spring and fall extend west-northwest through the State, say parallel with a line running through Chattanooga and Trenton or thereabout. This shows the southwestern corner to be the warmest, and here is our greatest center of cotton culture. The greater warmth stimulates the cotton, and by throwing back the killing frosts increases the length of the growing season. The soils have their influence, but that they are not dominant in this distribution of percentage culture is shown by the fact that as we go north the decrease occurs, though the soils and elevation remain essentially the same. It is also noteworthy that as we go eastward from each of the two centers of cotton culture (the southwesterly corner of the State and the southern part of the central basin) the percentage of cotton culture rapidly decreases. The temperature and higher elevation obviously have much to do with this decrease.

Dr. R. H. Loughridge, in the same work already quoted from, makes the following comments concerning the extent of cotton growth in Texas in 1880:

> In 1869 the region of cotton cultivation extended nearly half way across the State from east to west, and embraced in its limits about 108,000 square miles, or about 41 per cent. of the land area. A line marking its western limit would pass southward from Red River, through the counties of Montague, Wise, Parker, Erath, and Hamilton to Atascosa, and thence eastward to Matagorda County.
>
> A line marking the limit for 1879 would pass from Red River, in Wichita County, southwest into Jones and Taylor, and south through Coleman, McCulloch, Mason, Kerr, Bandera, and Uvalde to the Nueces River, which it would follow nearly to the Gulf. Small spots of cotton production (49 acres altogether) occur also on the Rio Grande in Cameron and Hidalgo counties.

As will be hereafter shown, there is no reason to believe that the area of the cotton belt has extended much beyond the western limit given by Dr. Loughridge in the above extract. We may, therefore, conclude that the outlines on the map practically limit the cotton belt in 1891. The penumbral shades are of little importance in the discussion of the climatological effects on the cotton, because these outlying areas are only the sections where the cultivation of the plant is conducted under the most favorable conditions of the seasons. It must be understood that these exceptions apply only to the extreme northern and western limits and not to the lighter shades located in the interior of the cotton belt. Here other causes must be considered to explain the small production of the staple. Among the number may be mentioned the character of the land as well as the elevation.

The use of commercial fertilizers has greatly improved the qualities of the cotton and made it possible to cultivate lands that were heretofore considered inadequate to the demands of the plant. Before the late war it was the custom among southern farmers to cultivate a piece of land until its natural resources were about exhausted and then clear up a new piece from the native forests that then covered the largest portions of the Southern States. The old fields were turned out to grow up in pines or left to waste still more under the influence of the washing rains of winter, until the whole cotton region in 1860 seemed to be one vast belt of exhausted, badly washed lands. Since the use of fertilizers became so universal, however, attempts have been made to reclaim these wornout lands, and to-day many plantations in South Carolina, Georgia, and Alabama, that were cultivated in 1865 and considered to be practically ruined, have now been almost reclaimed and under favorable conditions are producing nearly as good results as when in their virgin state. This has been brought about by the restoration of the cotton seed to the lands as well as in the use of commercial fertilizers.

It must not be understood from what has been said that all lands in the cotton belt prior to 1860 were used for cotton culture, but, on

the contrary, it was found by experience that certain soils were better adapted to its growth than others. For instance, the "Black Belt" of Alabama, or the cretaceous formation, that passes across the middle portions of the State, monopolized the cotton cultivation in that portion of the South and little cotton planting was done outside of that region, or north of the thirty-third parallel. These lands were so rich in all the elements that perfect the plant that it was deemed unnecessary, until within the past few years, to use fertilizers of any character. The production was generally a bale to the acre and sometimes as much as a bale and half to the acre. But the constant cultivation of these lands without returning what had been taken from them has greatly impoverished what has heretofore been considered to be the richest and most valuable property in the world. The planters are now beginning to use fertilizers in this region and an effort is being made to restore the lands to their former remarkable productiveness. Dr. Hilgard, in speaking of these soils, says:

From the Chattahoochee west to the Nueces River of Texas, calcareous soils are widely prevalent; and the parallel map of intensity of cotton production shows a marked increase of the cotton culture whenever one of these calcareous belts is reached.

East of the Chattahoochee and northeastward to the James few prominently calcareous soil areas are met with, and all such are rather local and of small extent. The soils here, being derived from the eastern slope of the Alleghanies, are prevalently of a light siliceous character, and below the break of the highlands into the coast plains (or what is popularly known as "the falls of the rivers") they are but rarely influenced by the underlying tertiary marls. They are mostly what in a wide application of the term might be termed "alluvial" soils, chiefly of early quaternary origin; and, aside from the narrow "live oak belt" of the immediate coast, the long-leaf pine is their characteristic tree. This pine, as analysis shows, is everywhere an indication of soils poor in lime, and experience shows that until the use of fertilizers becomes part of the agricultural system only the bottom lands of a long-leaf pine area are usually utilized for cotton production. Hence the great pine belts of the Gulf coast produce but very little cotton, while on the Atlantic border, with the use of fertilizers, the culture is more extended.

Inland the proportion of lime in the soils usually increases, and correspondingly the long-leaf pine gradually gives way to the short leaf species and an increasing proportion of oaks and hickories, until finally the latter only occupy the ground. With local modifications, this order of things holds good pretty generally from Virginia to eastern Louisiana, but by far most strikingly so in the Gulf States east of the Mississippi. In the bottom plain of the latter, near the line between Arkansas and Louisiana, we find the maximum cotton production on natural soils on the highly calcareous and otherwise also profusely fertile "buckshot" soils of the great valley, with which only some of those of Red River bottom can dispute precedence. Under their influence cotton cultivation is carried far into Missouri, while in the hill country to the eastward and westward, in Kentucky and in northwestern Arkansas, it forms but a subordinate feature. In Texas again the tertiary and cretaceous prairie regions produce the bulk of upland cotton, while in the coast prairie region the river bottoms are almost alone employed in its production thus far; and westward of the cretaceous prairie region, where the rainfall becomes more scanty, it has not yet had time to establish itself on a permanent footing, save locally.

In other portions of the South the lands selected by the planters in

1860 as those best suited for the production of cotton were those of a soft, deep mold in which the color was darkened by a due admixture of decaying vegetable matter, a medium between spongy and sandy soils. These lands were generally found on creek and river bottoms. So it must be remembered that although cotton was planted on every plantation in the cotton belt, still there was a large proportion of the land throughout the country that was considered poorly adapted to its cultivation. It is now generally understood that any land in the belt that contains the necessary ingredients in an available form, and that is well drained, can be made to produce excellent grades of cotton. The loose, sandy soils of the coast regions, that were formerly thought to be unfit for profitable cotton culture, are now producing well under modern treatment. This may be said with equal force concerning the heavy clay lands of the hilly regions.

## II.—A GENERAL DISCUSSION OF THOSE COUNTRIES WHERE COTTON IS CULTIVATED TO ANY EXTENT.

In the discussion of the question of climatic effects on the growth and successful cultivation of cotton, it will be interesting to compare the climates of those countries where the plant seems to be indigenous with that of the Southern United States. I have selected for this purpose some of the most important of those countries where climatic data are available.

In making this comparison special attention is called to the fact that in no other country do we find such uniform distribution of rain throughout the year as we note in this southern land. And the gradual changes of temperature here during the summer months are more advantageous to the well-being of the tender cotton plant than are to be found in any other country on the globe, so far as the writer knows. It is unfortunate, however, that more extensive meteorological data from these foreign countries where cotton is cultivated can not be secured so as to bring out the points of comparison in more striking manner than is possible with such meager reports.

### WEST INDIES.

The temperature in this country ranges between 77° and 82°, and frosts are but seldom known. A short wet season begins in April and lasts from two to six weeks, followed by a dry season, when the thermometer remains almost stationary at 80°. The heat is very oppressive during July and August, and the summer is very dry. The great rainy season begins October 1 and lasts until December, when a dry spell follows, lasting until April 1. The annual rainfall is 63.00 inches. At Barbadoes the following record of temperature has been secured that shows very uniform results:

| | ° | | ° |
|---|---|---|---|
| January | 78. 0 | September | 82. 1 |
| February | 78. 0 | October | 82. 2 |
| March | 79. 1 | November | 81. 8 |
| April | 78. 2 | December | 79. 3 |
| May | 79. 6 | Spring | 79. 2 |
| June | 78. 1 | Summer | 78. 5 |
| July | 79. 0 | Autumn | 82. 1 |
| August | 78. 5 | Winter | 78. 5 |

The mean annual temperature is 79.5°. The maximum is 87° and the minimum is 75°. The annual rainfall is 57.74 inches.

### BRITISH INDIA.

It is thought that cotton is indigenous to the soil of this country. The cultivation has been carried on for many years with various degrees of success. It is believed by some authorities that the cotton plant came originally from this country, passing through Persia, Arabia, and Asia Minor, and probably to America. Upon this point, however, there is much doubt.

Commissioner Young, in his account of the cotton industry exhibited at the Paris Exposition in 1878, comments as follows concerning the cotton in India:

The samples of cotton from Mahratta, in India, and Dharwar, attracted my attention, as they seemed to be superior to most of the other Indian cottons. They are clean, bright cottons, but, like most of the Indian cottons, coarse and short. From this exhibition I learned that the cotton of all or nearly all of the Indian provinces has been greatly improved by the introduction of American seed. It was in Dharwar that our American planters obtained the greatest success, and I am told that the entire crop in this province is now from seed originally American. These districts are reported to enjoy a climate resembling that of the American Gulf States, never excessively dry and never overflowed with excessive rains. In 1844 there were, it is said, 1,200 acres planted in American seed; in 1848 between 18,000 and 20,000; and in 1860 the crop was said to be over 2,000,000 pounds. When the American war of secession seemed inevitable, England proposed again to husband the production of cotton in India, for it appears that, for some reason, the American planters who had been employed years previously to instruct the people of India in the culture of cotton had left the country and returned to their homes, and that after their departure the production seemed to diminish, while the improved implements of agriculture which had been introduced by them had been thrown away, or at least passed out of use by the natives. One author states that some English plows were introduced by the agent, when at first the natives were greatly astonished at their results and admired them extravagantly; but when the agent turned his back they painted the plow red, turned it up on end and worshiped it, and returned to the use of their original clumsy utensils. The attempts of England to produce her own supplies of cotton from her own territory, and thus become independent of the product of America, seem to have been a failure. Nor has the experience in India been exceptional, for about the same period an attempt was made to extend its cultivation to Africa.

This country is one of the most important outside of the United States that is now engaged in the cultivation of cotton, and a meteoro-

logical comparison, therefore, will be interesting in the discussion of the subject now before us.

The seasons in India are naturally divided into cold, hot, and rainy periods. The stations in different parts of the country give very marked differences in temperature and rainfall. The climate is greatly influenced by the two monsoons that blow from the northeast and southwest. Great extremes of temperature and moisture precede and accompany these monsoons, so that the cotton plant suffers very much under the trying changes. All India does not suffer so greatly under the influence of these monsoons and the cotton plant in some sections gives very good results. For the purposes of this paper the following stations have been selected as occupying the most important parts of the cotton region of that country:

TABLE I.—*Mean temperature of several stations in India.*

| Stations. | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Year. | Elevation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | *Feet.* |
| Singapore | 86 | 88 | 89 | 85 | 85 | 87 | 88 | 86 | 87 | 87 | 86 | 85 | 86.6 | Sea. |
| Madras | 75.5 | 77.7 | 80.8 | 83.7 | 86.8 | 87.7 | 85.3 | 84.6 | 83.7 | 82 | 78.9 | 76 | 81.9 | Sea. |
| Calcutta | 66 | 69.8 | 80 | 85.4 | 85.7 | 83.7 | 81.8 | 82 | 82 | 79.2 | 74.2 | 66 | 78 | Sea. |
| Benares | 62.6 | 72.5 | 79 | 89.9 | 94.4 | 90.3 | 85.7 | 85.7 | 86 | 81.5 | 72 | 64 | 80.3 | 300 |
| Cawnpore | 63 | 69 | 72.2 | 88.6 | 96 | 91.2 | 80.7 | 87 | 85 | 79 | 75.3 | 67 | 80 | 500 |
| Surouli | 51.4 | 59.3 | 67.2 | 75.0 | 82.5 | 87.8 | 88.6 | 88.9 | 77.8 | 72.3 | 60.3 | 49 | 71.7 | 800 |
| Seharunpoor | 52.1 | 63.3 | 68.0 | 79.0 | 86.1 | 89.0 | 86.8 | 85.3 | 78.0 | 74.0 | 64.8 | 56 | 73.5 | 1,000 |
| Dehra Doon | 52.1 | 59.1 | 67.0 | 73.0 | 81.0 | 86.0 | 83.0 | 81.0 | 78.1 | 73.1 | 57.0 | 56 | 70.5 | 2,350 |

TABLE II.—*Annual precipitation at certain stations in India.*

| Stations. | Amount. | Stations. | Amount. |
|---|---|---|---|
| | *Inches.* | | *Inches.* |
| Bombay | 68.73 | Colapoor | 30.74 |
| Butnagherry | 114.55 | Poonah | 19.02 |
| Tanna | 106.16 | Nassuck | 26.72 |
| Dapoolee | 134.96 | Belgaum | 40.90 |
| Kundaillah | 141.59 | Dharwar | 38.81 |
| Mahableshwur | 254.84 | Ahmednuggur | 21.83 |
| Paunchgunnee | 50.69 | Shorapore | 32.16 |
| Sattarah | 39.20 | Madras | 37.20 |

The mean monthly precipitation at Madras is as follows:

| | ° | | ° |
|---|---|---|---|
| January | 1.33 | July | 3.20 |
| February | 0.23 | August | 5.24 |
| March | 0.36 | September | 4.76 |
| April | 0.63 | October | 10.09 |
| May | 1.03 | November | 12.43 |
| June | 2.03 | December | 3.25 |

The mean annual temperature of Bombay for the cotton year, from June to February, is 90°. The mean monthly temperature at Calcutta ranges from 66° in January to 85.7° in May. The winter mean is 67.3°; for spring it is 83.7°; for summer it is 82.5°, and for au-

tumn it is 78.5°. One authority says "it is a remarkable fact in the cultivation of cotton in this country, where the plant lives from six to ten years, that the fiber produced is very inferior to that produced in the United States, and yet the seed from India that have been planted in the Southern States have invariably produced much more superior grades of cotton than that secured from similar seed in India. On the other hand, seed carried from the United States to India invariably deteriorated. This would indicate that the climate of the South has much to do with the improved character of the fiber that makes it the finest cotton of any produced in the world." The annual rainfall at Calcutta is 64.00 inches, but, as the above table shows, the seasons of rain are quite variable in India. The hot period in this country of India is from March to May, and during this time the temperature often goes as high as 100° to 110°, accompanied with tremendous thunderstorms.

MEXICO.

The area in which cotton is found in this country is quite limited, but the plant grows wild and is apparently native to the country. At Vera Cruz the mean annual temperature is 77°, while the range of temperature between the hottest and coldest months is only 12.4°.

The following gives the mean temperature for each month in the year:

| | ° | | ° |
|---|---|---|---|
| January | 70.0 | July | 81.5 |
| February | 71.6 | August | 82.4 |
| March | 73.4 | September | 81.0 |
| April | 72.2 | October | 78.4 |
| May | 80.5 | November | 75.4 |
| June | 81.9 | December | 71.1 |

AUSTRALIA.

The cotton is also indigenous to this country and the fiber is generally picked from the same plant for five years. The frosts that occur are usually so light the cotton is not killed and the plant continues to grow from year to year. The seeds are planted in September and the picking begins in February and continues until June. The temperature during the cotton months ranges from 60° to 100°. The mean annual temperature at Sydney is 62.4°; at Victoria it is 56.8°, the lowest being 27° and the highest 111°. The character of fiber produced is coarse and not of that fine texture and length found in the United States. The rainfall at Melbourne is only 25.66 inches.

BRAZIL.

The best samples of cotton in this country come from Pernambuco. The climate in some respects is well adapted to the cultivation of

cotton. The plant bears fruit throughout the year. Planting takes place in November and the first flowers open in June, and the flowering continues freely throughout the entire year. The temperature ranges from 24° to 104°.

Mr. O. H. Dockery, consul-general of the United States at Rio de Janeiro, in a report made to his Government gives the following interesting account concerning the climate of Brazil:

The mean temperature in the country between Rio de Janeiro and the Amazon is 78.8° above zero; that of the Amazon is 80.6°. In no part of Brazil is it hardly ever higher than 96.8°.

Count du Chaillou states as follows concerning the temperature of this country:

At the city of Rio de Janeiro, which is situated on the boundary line of the torrid and temperate zones, the average temperature, according to the Annuario do Imperial Observatorio for 1887, is 74.1° F., according to thirty-six years of observations. Only two seasons are known here, summer, or the rainy season, which lasts from October to the end of March, and winter, or the dry season, which lasts from April to September. The average temperature of summer is about 78.8°, and that of winter 69.8°. The highest temperature noted was 99.5°, and the lowest 50.3°, which is about the average temperature of Paris. The difference in the winter and summer temperature is, therefore, very slight in reality, but the long continuance of the heat and the warm nights make the heat keenly felt.

The following extracts were taken from a work prepared by the Brazilian Government for the Paris Exposition:

During all the dry season the prairies, which serve as pasturage for the immense herds of cattle which are to-day one of the chief sources of provincial wealth, are completely dried and burned up by the sun. The live stock, whose weak and lean condition renders them pitiful objects, retire into wooded districts and subsist as best they may upon half dried leaves till the return of the rainy season. Vast tracts which then seemed calcined and sterile are in a few weeks covered with a luxuriant vegetation, and in a short time the cattle become fat and vigorous. But unfortunately it quite frequently happens that the rainy season, instead of following the dry, does not come for a whole year or several years. The subtropical region may be divided with relation to its rainfall into two distinct parts. * * * The first includes Alagoas, Sergipe, the coast of Bahia, and we will add Pernambuco. That part receives a rainfall every year, but the largest quantity occurs in June, July, and August. The southern part of Bahia, the provinces of Espirito Santo, Rio de Janeiro, a part of the coast of São Paulo, and the eastern part of Minas Geraes constitute the remainder of the subtropical zone. This subdivision is characterized by a predominance of rain, especially during the autumn and summer; that is from December to April. * * * The south of the province of São Paulo, the provinces Paraná, Santa Catharina, and Rio Grande do Sul constitute the third large division of Brazil. The temperature is very mild here, the average being below 68°, and the climate one of the finest in the world. * * * The rainy season is unlike that of any other region of the empire. In proportion as one leaves the equator the change from the dry to the wet season becomes less marked, while the breadth of variation in the temperature during the different months increases constantly.

The following tables are taken from the same work, and they give meteorological data at stations located near the equator to a point as far south as 32°:

TABLE III.—*Meteorological data, Brazil.*

| Stations. | Latitude. | | Altitude. | Temperature. | | | Annual rainfall. |
|---|---|---|---|---|---|---|---|
| | | | | Mean annual. | Max. | Min. | |
| | ° | ′ | *Feet.* | ° | ° | ° | *Inches.* |
| Maranhão, Maranhão | 1 | 27 | 142 | 81.32 | 92.84 | 69.98 | 96.65 |
| Fortaleza, Ceará | 3 | 44 | ..... | 79.88 | ..... | ..... | 59.06 |
| Quixeramobim, Ceará | 5 | 16 | ..... | 84.74 | 92.48 | 76.64 | ..... |
| Amarante, Paranhyba | 6 | 13 | ..... | 80.78 | 95.90 | 64.40 | 6.30 |
| Recife, Pernambuco | 8 | 04 | 10 | 79.16 | 99.14 | 61.34 | ..... |
| Colonia da Victoria, Pernambuco | 8 | 09 | 528 | 77.18 | 102.20 | 52.88 | ..... |
| Colonia Isabel, Pernambuco | 8 | 45 | 751 | 74.66 | 95.90 | 52.70 | ..... |
| São Bento das Lages, Bahia | 12 | 37 | 98 | 76.64 | 95.00 | ..... | 80.83 |
| Bahia, Bahia | 12 | 58 | 210 | 78.80 | 88.70 | 35.78 | 85.16 |
| Queluz de Minas, Espirito Santo | 20 | 40 | ..... | 67.82 | 90.32 | 33.80 | 57.52 |
| Ribeirão Preto, Espirito Santo | 21 | 10 | 1,706 | 68.00 | 93.20 | 32.00 | 23.62 |
| Cascata, Rio de Janeiro | 21 | 53 | 4,167 | 64.40 | 104.00 | 32.00 | 51.18 |
| Nova-Friburgo, Rio de Janeiro | 22 | 19 | 2,874 | 62.96 | 84.20 | 33.80 | 51.73 |
| Rio de Janeiro, Rio de Janeiro | 22 | 54 | 217 | 74.30 | 99.50 | 50.36 | 44.33 |
| Santa Cruz, Rio de Janeiro | 22 | 56 | 85 | 71.96 | 97.88 | 66.56 | 184.33 |
| São Paulo, São Paulo | 23 | 33 | 2,395 | 62.24 | 91.58 | 30.38 | 59.06 |
| Coritiva, São Paulo | 25 | 27 | 2,953 | 64.22 | 100.40 | 24.08 | ..... |
| Colonia Nova-Petropolis, São Paulo | 26 | 48 | ..... | 66.38 | ..... | 42.62 | ..... |
| Colonia Blumenau, Paraná | 26 | 55 | ..... | 70.52 | ..... | ..... | 60.71 |
| S. Antonio de Palmeira, Paraná | 27 | 54 | 1,896 | 64.40 | 93.20 | 30.20 | ..... |
| Passo-Fundo, Santa Catharina | 28 | 28 | 2,060 | 62.78 | 93.92 | 32.00 | ..... |
| Taquara, Rio Grande do Sul | 29 | 40 | ..... | 65.66 | ..... | ..... | ..... |
| Santa Cruz, Rio Grande do Sul | 29 | 45 | ..... | 66.56 | 95.00 | ..... | ..... |
| Pelotas, Rio Grande do Sul | 31 | 46 | 6,152 | 62.96 | 99.50 | 31.10 | 41.97 |
| Rio Grande do Sul | 32 | 00 | 52 | 65.84 | 90.32 | 33.80 | 35.91 |

TABLE IV.—*Rainfall at certain points in the interior of Brazil, published by authority of the Brazilian Government.*

| Stations. | Summer. (Winter.) | Autumn. (Spring.) | Winter. (Summer.) | Spring. (Autumn.) | Total for year. |
|---|---|---|---|---|---|
| | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* |
| Valley of the upper Paranhyba | 16.10 | 46.60 | 0.00 | 7.30 | 38.00 |
| Sarbará | 35.80 | 11.00 | 1.50 | 16 10 | 64.40 |
| Congo-Soco | 59.60 | 18.60 | 4.30 | 32.90 | 115.40 |
| Itaibra do Campo | 28.90 | 8.80 | 0.00 | 13.60 | 51.30 |
| Queluz | 37.20 | 6.10 | 2.10 | 11.80 | 57.20 |
| Casa Branca | ..... | ..... | ..... | ..... | 39.40 |
| Height of Cubitão | 50.40 | 37.70 | 24.40 | 28.30 | 140.80 |

## ARGENTINE REPUBLIC.

Cotton grows in this country both as an annual and a perennial, and the culture is increasing each year. The following meteorological data have been extracted from the U. S. Agricultural Department's Miscellaneous Series, Report No. 2, by Almont Barnes, LL. B.:

The mean annual temperature of the Argentine Republic is about the same as that of the United States; that is to say, that both countries are included within the limits of similar isothermal lines, from 70 to about 40 in the latter country, exclusive of the Florida peninsula, and also from 70 to about 40 in the former. The average range of the thermometer is therefore about the same. Both are situated geographically and as to range of climate within so-called temperate zones, and other things being equal the character and range of productions of the two would be the same.

As in the case of other South American countries, the meteorological statistics of the Argentine Republic are few, fragmentary, and not representative of large regions. Premising that nearly the whole length of the coast of the country is swept or approached by the warm Brazilian ocean current, a branch of the great equatorial one, and that the estuary of the Rio de la Plata is constantly filled with water drawn in large bodies from

the tropics, both of which are modifying influences as to temperature and humidity, such classified and tabulated facts as are to be had and seem of value are presented in the following tables. The first tables relate to isolated stations, more or less representative of surrounding districts or provinces of the middle portion of the country relative to north and south, and of the entire breadth of that area east of the Andes.

They are taken from Dr. Burmeister's work, wherein the temperature is given according to the Réaumur scale, and the rainfall in millimeters, and reduced for use herein to Fahrenheit standard and to inches, respectively:

TABLE V.—*Maximum and minimum temperature at Buenos Ayres and monthly averages of the same for the four years ending with August*, 1873.

| Months. | Maximum. | | | | | Minimum. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1870. | 1871. | 1872. | 1873. | Average. | 1870. | 1871. | 1872. | 1873. | Average. |
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| September | 81.05 | 71.38 | 74.75 | 74.75 | 75.43 | 39.43 | 38.75 | 34.25 | 38.75 | 37.75 |
| October | 74.75 | 78.80 | 74.75 | 82.63 | 77.68 | 43.25 | 43.25 | 41.00 | 46.63 | 43.48 |
| November | 88.25 | 86.90 | 78.80 | 86.00 | 85.10 | 44.83 | 43.25 | 42.13 | 43.25 | 43.48 |
| December | 93.65 | 99.95 | 92.75 | 92.30 | 94.78 | 53.38 | 60.13 | 52.25 | 51.13 | 54.28 |
| January | 93.65 | 96.80 | 97.25 | 90.95 | 93.65 | 52.25 | 53.60 | 51.13 | 57.88 | 53.83 |
| February | 89.38 | 90.05 | 90.05 | 88.25 | 89.38 | 59.00 | 58.10 | 53.38 | 54.50 | 56.30 |
| March | 83.75 | 88.25 | 83.75 | 82.63 | 85.55 | 52.03 | 53.83 | 47.30 | 47.75 | 50.23 |
| April | 73.85 | 80.60 | 78.80 | 77.00 | 77.68 | 40.55 | 37.63 | 38.75 | 41.00 | 39.43 |
| May | 69.80 | 68.00 | 63.50 | 70.25 | 68.00 | 34.25 | 34.25 | 35.38 | 31.33 | 33.80 |
| June | 65.75 | 70.25 | 70.25 | 69.13 | 68.90 | 30.88 | 33.13 | 34.25 | 32.00 | 32.68 |
| July | 64.63 | 66.88 | 65.75 | 73.63 | 67.78 | 32.45 | 29.75 | 29.75 | 34.25 | 31.55 |
| August | 66.65 | 72.50 | 66.88 | 72.50 | 69.58 | 29.75 | 35.38 | 36.50 | 35.38 | 34.25 |
| Average | | | | | 79.46 | | | | | 42.59 |

TABLE VI.—*Mean monthly, seasonal, and annual temperature at Buenos Ayres, and mean for four years ending with August*, 1873.

| Months and seasons. | 1870. | 1871. | 1872. | 1873. | Average monthly. |
|---|---|---|---|---|---|
| | ° | ° | ° | ° | ° |
| September | 57.43 | 54.06 | 52.03 | 57.20 | 55.18 |
| October | 58.55 | 60.80 | 59.90 | 65.98 | 61.31 |
| November | 64.63 | 57.43 | 63.73 | 66.88 | 63.28 |
| Spring mean | 60.20 | 57.43 | 58.55 | 63.35 | 59.88 |
| December | 71.38 | 75.43 | 71.60 | 71.83 | 72.56 |
| January | 73.40 | 74.98 | 74.30 | 76.33 | 74.78 |
| February | 75.43 | 74.53 | 71.38 | 72.28 | 73.40 |
| Summer mean | 73.40 | 74.98 | 72.43 | 73.48 | 73.58 |
| March | 70.48 | 70.03 | 65.30 | 68.00 | 68.45 |
| April | 61.03 | 59.00 | 63.73 | 60.58 | 61.08 |
| May | 55.85 | 54.28 | 51.80 | 54.28 | 54.05 |
| Autumn mean | 62.45 | 61.10 | 60.27 | 60.95 | 61.19 |
| June | 50.00 | 50.68 | 50.00 | 52.03 | 50.68 |
| July | 47.75 | 47.75 | 48.43 | 47.53 | 47.86 |
| August | 48.20 | 51.35 | 52.70 | 53.83 | 51.52 |
| Winter mean | 48.66 | 49.93 | 50.38 | 51.13 | 50.02 |
| Average for the year | 61.18 | 60.86 | 60.41 | 62.22 | 61.17 |

The tables substantially agree in giving the range of the temperature at Buenos Ayres as from about 48° to 100° during the producing seasons for farm products, with an annual mean of about 76° during those months. The prevailing temperature may therefore be considered exceptionally good for crops suited to a temperate climate.

Monthly, seasonal, and annual rainfall, actual and mean, at Buenos

Ayres, for the eight years ending with 1868, taken by M. Eguia, and approved by Dr. Burmeister:

TABLE VII.—*Monthly, seasonal, and annual rainfall at Buenos Ayres.*

| Month and season. | 1861. | 1862. | 1863. | 1864. | 1865. | 1866. | 1867. | 1868. | Means. |
|---|---|---|---|---|---|---|---|---|---|
| | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* | *Inches.* |
| September | 2.50 | 3.06 | 1.64 | 4.10 | 2.75 | 1.40 | 1.17 | 3.56 | 2.53 |
| October | 5.93 | 4.88 | 0.58 | 1.30 | 2.50 | 9.75 | 0.24 | 5.82 | 3.87 |
| November | 0.69 | 3.37 | 0.88 | 1.57 | 0.58 | 2.23 | 3.00 | 3.93 | 2.03 |
| Spring | 9.12 | 11.31 | 3.11 | 6.97 | 5.83 | 13.38 | 4.41 | 13.31 | 8.43 |
| December | 4.64 | 6.04 | 3.60 | 2.39 | 1.59 | 3.19 | 3.75 | 6.41 | 3.95 |
| January | 0.45 | 0.51 | 4.25 | 1.42 | 2.05 | 0.56 | 0.41 | 2.53 | 1.52 |
| February | 1.22 | 4.04 | 3.89 | 1.95 | 0.29 | 1.98 | 1.31 | 6.91 | 2.70 |
| Summer | 6.31 | 10.59 | 11.74 | 5.76 | 3.93 | 5.72 | 5.47 | 15.85 | 8.17 |
| March | 1.20 | 2.69 | 2.83 | 3.35 | 0.98 | 1.24 | 1.51 | 4.28 | 2.26 |
| April | 2.87 | 1.94 | 0.49 | 3.82 | 4.25 | 2.98 | 4.88 | 1.79 | 2.88 |
| May | 0.12 | 5.67 | 3.92 | 3.16 | 2.82 | 5.19 | 1.18 | *3.01 | 3.01 |
| Autumn | 4.19 | 10.29 | 6.24 | 10.33 | 8.05 | 9.41 | 7.57 | 9.08 | 8.14 |
| June | 0.70 | 4.88 | 2.92 | 3.00 | 4.53 | 2.93 | 2.75 | 3.37 | 3.14 |
| July | 0.48 | 2.92 | 0.99 | 1.45 | 2.47 | 6.22 | 2.74 | 0.21 | 2.19 |
| August | 2.19 | 1.26 | 2.61 | 1.74 | 2.51 | 2.13 | 0.35 | 3.16 | 1.99 |
| Winter | 3.37 | 9.06 | 6.52 | 6.19 | 9.50 | 11.28 | 5.85 | 6.74 | 7.32 |
| The year | 22.99 | 41.25 | 27.62 | 29.26 | 27.31 | 39.80 | 23.29 | 44.97 | 32.06 |

*Amount not given in this single instance, and therefore the average amount is assumed for it.

## EGYPT.

Upper Egypt is almost entirely rainless, while Lower Egypt has a small rainfall. In Lower Egypt the mean temperature ranges from 80° to 90° in summer and from 50° to 60° in winter. In Upper Egypt the mean temperature in summer ranges from 90° to 100°, and from 60° to 70° in winter. Cotton is cultivated by artificial irrigation, and is mostly to be found in Lower Egypt, the upper country being too dry.

The following table gives, in an interesting manner, the general comparison between the several foreign countries considered in this paper and the cotton belt of the southern United States. The mean temperatures and annual precipitations are too general to bring out specific differences, but they will serve to show the striking contrasts between the several countries under consideration:

TABLE VIII.—*Comparative temperature and rainfall.*

| Countries. | Temperature. | | | Annual precipitation. |
|---|---|---|---|---|
| | Mean annual. | Mean spring. | Mean summer. | |
| | ° | ° | ° | *Inches.* |
| United States (cotton belt) | 63.5 | 63.5 | 78.0 | 50.80 |
| West Indies | 79.5 | 78.9 | 78.5 | 63.00 |
| British India | 77.8 | 81.8 | 86.2 | 74.22 |
| Mexico (Vera Cruz) | 76.6 | 75.3 | 82.0 | ..... |
| Australia (Sydney and Victoria) | 59.6 | ..... | ..... | ..... |
| Brazil (Rio Grande do Sul) | 65.6 | 63.8 | 74.7 | *72.36 |
| Argentine Republic (Buenos Ayres) | 61.2 | 69.9 | 73.6 | 32.06 |
| Egypt, Lower (Alexandria) | ..... | ..... | 76.6 | 7.51 |

* Entire country.

NOTE.—The mean temperature of the portion of Brazil between Rio de Janeiro and the Amazon is 78.8°. That of the Amazon is 80.6°; and the summer temperature (winter) of Pernambuco is 79.5°, while the winter (summer) temperature is 76.8°. A large portion of the cotton of Brazil is grown in Pernambuco.

## III.—THE GENERAL CLIMATIC FEATURES PREVAILING IN THE SOUTHERN UNITED STATES DURING THE PREPARATION OF THE LAND FOR THE PLANTING OF THE SEED.

The winters of the South are seldom severe, and the temperature rarely reaches zero except in the more northern latitudes of the cotton region, and not often even there. It is a well recognized fact among cotton planters that those portions of the country where the changes of temperature are sudden and the fall reaches zero during every winter and sometimes frequently during the same winter, will permit of too short a period between frosts to enable the cotton plant to perfect its growth and mature its fruit. Many efforts have been made to force the plant to produce fiber in the northern portions of Kentucky and the colder regions in west and northwest Texas, but all such efforts have proved total failures, even though the general conditions of the soil in those sections of the country are of a nature well suited for the cultivation of cotton.

The following table of winter temperatures at those stations in the cotton region giving continuous records for ten years or more, is given to bring out the above conclusions in regard to the growth of cotton. A careful comparison of this table with the outline map, Chart VII, will show that wherever the altitude or latitude causes the temperature to range low during the winter and spring months the cultivation of cotton is correspondingly reduced to a minimum:

TABLE IX.—*Winter minimum temperatures at stations of the cotton belt of the Southern States.*

| Stations. | Length of record. | Minimum. | Month and year. | Mean minimum. | | | No. of times min. was down to zero and below. |
|---|---|---|---|---|---|---|---|
| | | | | December. | January. | February. | |
| *Northern portion.* | *Years* | ° | | ° | ° | ° | |
| Atlanta, Ga | 13 | — 2 | Jan., 1886 | 37.6 | 35.4 | 39.7 | 2 |
| Charlotte, N. C | 13 | — 5 | Dec., 1880 | 35.5 | 33.8 | 37.4 | 2 |
| Chattanooga, Tenn | 13 | — 7 | Jan., 1886 | 35.6 | 34.0 | 37.7 | 2 |
| El Paso, Tex | 14 | — 5 | Dec., 1880 | 32.9 | 30.7 | 35.8 | 2 |
| Fort Davis, Tex | 11 | — 3 | Jan., 1886 | 33 2 | 30.1 | 34.8 | 2 |
| Fort Elliott, Tex | 10 | —14 | Jan., 1888 | 25.6 | 18.7 | 24.2 | 12 |
| Fort Smith, Ark | 10 | — 7 | Jan., 1886 | 33.8 | 26.8 | 32.3 | 3 |
| Knoxville, Tenn | 21 | —16 | Jan., 1884 | 32.3 | 30.6 | 34.2 | 7 |
| Little Rock, Ark | 13 | — 5 | Jan., 1886 | 38.5 | 33.7 | 38.0 | 1 |
| Memphis, Tenn | 20 | — 8 | Jan., 1886 | 38.1 | 32.8 | 37.7 | 2 |
| Nashville, Tenn | 21 | —10 | Jan., 1884 | 33.9 | 30.5 | 34.1 | 9 |
| *Middle portion.* | | | | | | | |
| Auburn, Ala | 14 | 3 | Jan., 1884 | 39.7 | 38.2 | 44.8 | 0 |
| Augusta, Ga | 20 | 0 | Jan., 1886 | 39.0 | 38.8 | 42.0 | 0 |
| Charleston, S. C | 20 | 10 | Jan., 1886 | 44.8 | 44.5 | 46.2 | 0 |
| Green Springs, Ala | 27 | 2 | Jan., 1886 | ..... | ..... | ..... | 0 |
| Hatteras, N. C | 17 | 8 | Dec., 1880 | 42.0 | 39.3 | 41.9 | 0 |
| Kittyhawk, N. C | 17 | 5 | Feb., 1886 | 40.1 | 36.6 | 39.4 | 0 |
| Montgomery, Ala | 19 | 5 | Jan., 1886 | 40.6 | 40.1 | 44.4 | 0 |
| Palestine, Tex | 10 | 0 | Jan., 1886 | 42.6 | 38.3 | 43.8 | 1 |
| Shreveport, La | 20 | 1 | Jan., 1886 | 41.6 | 38.2 | 43.1 | 0 |
| Union Springs, Ala | 24 | 8 | Jan., 1886 | ..... | ..... | ..... | 0 |
| Vicksburg, Miss | 20 | 3 | Jan., 1886 | 42.7 | 39.9 | 44.2 | 0 |
| Wilmington, N. C | 21 | 9 | Jan., 1884 | 39.9 | 38.9 | 41.5 | 0 |

TABLE IX.—*Winter minimum temperatures, &c.*—Continued.

| Stations. | Length of record. | Minimum. | Month and year. | Mean minimum. | | | No. of times min. was down to zero and below. |
|---|---|---|---|---|---|---|---|
| | | | | December. | January. | February. | |
| *Southern portion.* | *Years* | ° | | ° | ° | ° | |
| Brownsville, Tex | 16 | 18 | {Dec., 1880 / Jan., 1881} | 53·5 | 50.0 | 55·2 | 0 |
| Cedar Keys, Fla | 10 | 15·5 | Jan., 1886 | 51·4 | 51.0 | 54·9 | 0 |
| Galveston, Tex | 21 | 11 | Jan., 1886 | 51·5 | 47·4 | 52·9 | 0 |
| Indianola, Tex | 14 | 12 | Jan., 1886 | 50.1 | 43·8 | 49·9 | 0 |
| Jacksonville, Fla | 20 | 15 | Jan., 1886 | 49·1 | 47·5 | 50·8 | 0 |
| Mobile, Ala | 21 | 11 | Jan., 1886 | 44·4 | 43·6 | 47·6 | 0 |
| New Orleans, La | 21 | 15 | Jan., 1886 | 48·7 | 47·3 | 51.2 | 0 |
| Pensacola, Fla | 12 | 15 | Jan., 1886 | 47·3 | 46·3 | 51.0 | 0 |
| Rio Grande City, Tex | 15 | 19 | Jan., 1881 | 50·5 | 47·7 | 54·2 | 0 |
| San Antonio, Tex | 15 | 6 | Jan., 1886 | 45·2 | 41.0 | 46·8 | 0 |
| Savannah, Ga | 21 | 12 | Jan., 1886 | 44·4 | 43·7 | 46·9 | 0 |

The records from which these results have been secured cover periods from ten to twenty-one years.

For convenience of reference and comparison I have divided the region under discussion into three distinct portions, viz., northern, middle, and southern sections of the cotton belt. The lines separating these divisions are irregular and will more nearly coincide with the normal lines of mean minima temperatures than with the lines of latitude. In arranging the stations under this classification I have been governed largely by the mean minima temperatures recorded by the respective observers; but to correctly express the severity of the climate in winter it is best also to consider the lowest possible range of temperature. With this interpretation, therefore, I have placed Atlanta, Ga., Little Rock, Ark., and Memphis, Tenn., in the northern division, although the mean minima would warrant placing them in the middle section. When the question of the growth of cotton is considered, however, it will be noticed that the conditions of climate and soil are amply propitious for all demands of the plant in the country surrounding these three cities.

Those sections in Texas placed in the northern division, that are situated far south geographically, give greater depressions of temperature than those in the east not so far south. This is largely due, no doubt, to the greater altitude, in some instances, of these western stations, and also because of the blizzards that sweep across portions of Texas each year. At the following stations where the minimum temperature goes so low and so frequently during the winter, there is very little, if any, cotton planted; and in the neighboring country where the cultivation has been attempted results have been very discouraging, viz., El Paso, Fort Elliott, Fort Smith, Knoxville, and Nashville. In the case of Nashville, however, there is a section of country just south of the city that produces very large yields of cotton

in favorable years. It will thus be noticed that although some of the stations occupy positions quite far north local causes may so modify the climatic conditions as to permit the successful cultivation of cotton in the immediate neighborhood.

The months of February and March are spent by the planters in preparing the land for the planting of the seed, and the season is very well adapted for such work. The weather is never severe enough to prevent outdoor work, and the ground is never so hard frozen as to impede the progress of the plow.

In the lower half of the Southern States the fall of snow is very unusual, and even in the more northern limits it scarcely covers the ground above a few inches and remains only a few days at the most. It is possible, therefore, under these conditions, for the farmers to work almost continually during the winter months. The lands are generally plowed broadcast in the winter so that the rains and the frosts may disintegrate the soil and render the ingredients available to the demands of the plants. The plowing usually begins about the 1st of February and continues until planting of the seed in April or May, depending, of course, upon the locality of the place. In winter the rains are frequent and the soil is often soaked. The freezing of this water at night and quick thawing under the influence of the noonday sun cause great changes to take place in the chemical and physical conditions of the soil.

## IV.—THE CLIMATE OF THE SEED-PLANTING SEASON.

The heavy frosts in the South have generally ended by the 15th of April, and there is little danger of the young cotton plant becoming killed if it is planted so as to germinate about the 1st of May. It is customary, therefore, to put the seed in the ground from April 1 to May 10, the time depending largely upon the locality in the cotton belt. With the exception of the extreme south the cotton that is planted before the 15th of April is apt to become reduced in its vitality by cool nights that prevail during the first half of April. In most sections of the cotton belt light frosts, with occasional killing frosts, frequently retard the growth of vegetation during the first weeks of April, particularly in the northern limits of the region. It is therefore customary in those portions of the belt to delay the planting until the first week in May so as to escape this period of cool weather. To bring out this fact the following table of the times of killing frosts in the spring is given:

TABLE X.—*Dates of last killing frosts in the cotton belt, exhibiting early and backward springs, from* 1871 *to* 1891, *inclusive.*

ALONG THE NORTHERN LIMIT.

| Stations. | Earliest. | Latest. | Average. |
|---|---|---|---|
| Atlanta, Ga | February 2, 1882 | April 8, 1886 | March 17. |
| Charlotte, N. C | March 10, 1884 | May 3, 1879 | March 30. |
| Chattanooga, Tenn | January 25, 1880 | April 8, 1886 | March 18. |
| El Paso, Tex | March 7, 1885 | April 22, 1882 | March 31. |
| Fort Davis, Tex | February 25, 1888 | April 22, 1884 | April 1. |
| Fort Elliott, Tex | March 2, 1890 | April 30, 1880 | April 6. |
| Fort Smith, Ark | March 9, 1884 | April 5, 1887 | March 22. |
| Knoxville, Tenn | March 17, 1890 | April 25, 1883 | April 7. |
| Little Rock, Ark | February 22, 1882 | April 14, 1881 | March 21. |
| Memphis, Tenn | February 25, 1889 | April 16, 1882 | March 31. |
| Nashville, Tenn | February 2, 1882 | May 1, 1886 | March 28. |

THROUGH THE MIDDLE PORTION.

| | | | |
|---|---|---|---|
| Auburn, Ala | March 11, 1889 | April 6, 1886 | March 23. |
| Augusta, Ga | February 6, 1882 | April 14, 1885 | March 18. |
| Charleston, S. C | January 4, 1882 | April 2, 1881, 1887 | February 25. |
| Hatteras, N. C | January 4, 1882 | April 5, 1881 | February 23. |
| Kittyhawk, N. C | January 18, 1878 | April 19, 1875 | March 12. |
| Montgomery, Ala | February 2, 1882 | April 6, 1886 | March 8. |
| Palestine, Tex | February 24, 1889 | April 7, 1886 | March 17. |
| Shreveport, La | January 12, 1887 | April 7, 1886 | February 24. |
| Vicksburg, Miss | January 16, 1874 | April 6, 1886 | February 27. |
| Wilmington, N. C | January 23, 1882 | April 20, 1890 | March 14. |

ALONG THE SOUTHERN LIMIT.

| | | | |
|---|---|---|---|
| Brownsville, Tex | December 26, 1880 | March 1, 1890 | January 29. |
| Cedar Keys, Fla | December 7, 1887 | March 12, 1888 | January 22. |
| Galveston, Tex | December 26, 1880 | March 1, 1890 | January 27. |
| Indianola, Tex | November 30, 1878 | April 14, 1881 | February 7. |
| Jacksonville, Fla | December 18, 1880 | March 23, 1883 | February 3. |
| Mobile, Ala | December 27, 1880 | April 6, 1886 | February 21. |
| New Orleans, La | November 26, 1882 | March 14, 1886 | January 13. |
| Pensacola, Fla | December 27, 1880 | March 23, 1881, 1885 | February 24. |
| Rio Grande City, Tex | December 16, 1882 | March 2, 1890 | January 24. |
| San Antonio, Tex | December 7, 1878 | April 14, 1881 | February 11. |
| Savannah, Ga | January 4, 1882 | April 13, 1885 | February 26. |

April is a month of showers, and for this reason it is peculiarly well adapted for planting. These rains are not usually heavy, but occur at frequent intervals so as to keep the soil in that moist condition best suited to germinate the seed. It is a fact well known among scientists that if the soil becomes too heavily charged with water while the seed is undergoing the stage of transformation prior to germination decay frequently sets in, and on the other hand, if the soil is very dry, rendered so by the absence of rain or under the influence of drying winds, the seed cannot obtain enough moisture to start the growth and replanting becomes necessary. Again, if the soil contains a sufficiency of moisture for the growing plant, and the nights in early April are cool, the rapid evaporation from the leaf surface under the action of the winds may reduce the temperature so low as to seriously damage the organic structure of the tender vegetable. When chilling winds and not solar heat are the agents at work creating the circulation of moisture in the plant and reducing the amount of surplus water in the tissue, the young life is greatly en-

dangered and the vegetable organization is frequently disarranged or ruptured. It is the part of wisdom, therefore, obtained through long experience, that induces the cotton planter to delay putting in the seed until the latter part of April or first part of May, when the soil becomes warmed under the influence of the spring sun, and the number of cool days are reduced to the minimum.

The seasons of rain are so distributed throughout the spring months as to keep the atmosphere and soil in a condition generally suited for the full development of the young plant, and that causes the roots to take a deep hold of the soil and the tap root of the subsoil preparatory to contending against the droughts of summer. A very wet spring will cause the plant to form numerous surface roots, to the great sacrifice of the tap root and those that tend downward. Under these conditions the dry season that usually prevails during the summer months will soon cause the plant to wither and shed its "squares," because of the dry condition of the surface soil in which it is forced to live, and in which it must secure the moisture required for its growth. But if, on the other hand, the month of May is comparatively dry, with occasional showers interspersed throughout the month, the tap and lateral roots take deep hold of the soil and the subsoil, so that sufficient moisture is brought up from below to sustain the vitality of the plant during the fiber-forming period when plenty of sunshine and dry weather prevail. In this connection it will be interesting to note the following extract from Professor Johnson's work, "How Crops Feed," that shows in a striking manner how beneficial dews and frequent light showers during the growing period will become to the plant, and what great damage must result if our springs were seasons of continued rain, as is so common in many tropical regions of the world:

> Let us suppose dew or rain to have saturated the ground with moisture for some depth. On recurrence of a dry atmosphere, with sunshine and wind, the surface of the soil rapidly dries; but as each particle of earth escapes (by evaporation) into the atmosphere, its place is supplied (by capillarity) from the stores below. The ascending water brings along with it the soluble matters of the soil, and thus the roots of the plants are saturated in a stream of their appropriate food. The movement proceeds in this way so long as the surface is drier than the deeper soil. When by rain or otherwise the surface is saturated—it is like letting a thin stream of oil run upon the apex of the lamp-wick—no more evaporation into the air can occur, and consequently there is no longer any ascent of water; on the contrary, the water by its own weight penetrates the soil, and if the underlying ground be not saturated with moisture, as can happen where the subterranean fountains yield a meager supply, then capillarity will aid gravity in its downward distribution. * * * It is easy to see how, in a good soil, capillarity thus acts in keeping the roots of plants constantly immersed in a stream of water or moisture that is now ascending, now descending, but never at rest, and how the food of the plants is thus made to circulate around the organs fitted for absorbing it. * * * Thorough drainage, by loosening the soil and causing a rapid removal from below of the surplus water, has a most decided influence, especially in springtime, in warming the soil and bringing it into a suitable condition for the support of vegetation.

TABLE XI.—*Average rainfall, average number of rainy days, and average number of clear days for the month of May for the years* 1871 *to* 1891. *These averages were obtained from data furnished by all regular stations throughout the cotton belt.*

| Years. | Northern cotton belt. | | | Middle cotton belt. | | | Southern cotton belt. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rainfall (in inches). | No. of rainy days. | No. of clear days.* | Rainfall (in inches). | No. of rainy days. | No. of clear days.* | Rainfall (in inches). | No. of rainy days. | No. of clear days.* |
| 1871 | 4.66 | 12 | 8 | 6.12 | 8 | 16 | 4.30 | 9 | 9 |
| 1872 | 3.62 | 10 | 11 | 7.78 | 10 | 12 | 2.78 | 6 | 10 |
| 1873 | 5.56 | 12 | 4 | 7.63 | 12 | 8 | 8.86 | 13 | 7 |
| 1874 | 1.06 | 6 | 13 | 2.97 | 7 | 14 | 2.94 | 6 | 13 |
| 1875 | 2.97 | 12 | 10 | 2.79 | 7 | 11 | 3.20 | 7 | 12 |
| 1876 | 5.94 | 10 | 9 | 5.24 | 10 | 9 | 3.00 | 6 | 12 |
| 1877 | 1.53 | 6 | 14 | 3.00 | 6 | 15 | 1.67 | 6 | 11 |
| 1878 | 3.00 | 11 | 11 | 5.07 | 9 | 12 | 4.37 | 9 | 9 |
| 1879 | 3.52 | 8 | 13 | 3.54 | 10 | 13 | 3.00 | 6 | 14 |
| 1880 | 4.22 | 8 | 13 | 3.66 | 9 | 14 | 4.86 | 10 | 10 |
| 1881 | 3.34 | 11 | 10 | 2.57 | 8 | 10 | 2.40 | 7 | 11 |
| 1882 | 5.89 | 11 | 10 | 3.80 | 8 | 8 | 4.40 | 8 | 8 |
| 1883 | 3.34 | 7 | 15 | 3.66 | 6 | 11 | 4.32 | 7 | 11 |
| 1884 | 5.20 | 11 | 11 | 6.29 | 8 | 9 | 5.24 | 10 | 12 |
| 1885 | 4.35 | 12 | 11 | 6.57 | 12 | 8 | 5.40 | 11 | 7 |
| 1886 | 2.83 | 7 | 13 | 2.88 | 6 | 16 | 2.08 | 4 | 15 |
| 1887 | 3.68 | 12 | 11 | 4.06 | 11 | 10 | 3.90 | 9 | 10 |
| 1888 | 3.92 | 12 | 10 | 5.27 | 11 | 8 | 4.54 | 10 | 10 |
| 1889 | 2.51 | 7 | 15 | 2.66 | 6 | 15 | 1.08 | 4 | 15 |
| 1890 | 4.05 | 13 | 14 | 5.76 | 10 | 12 | 4.24 | 10 | 12 |
| 1891 | 2.67 | 6 | 13 | 2.85 | 6 | 13 | 1.92 | 4 | 13 |
| Mean | 3.71 | 10 | 11 | 4.48 | 9 | 12 | 3.74 | 8 | 11 |

*No estimate is made in these columns for the sunny weather that occurred during what are technically termed "fair days," but the averages represent only those days that have furnished less than one per cent. of cloudiness.

It will be seen from the accompanying table that May is comparatively a dry month—just enough rain falling to enable the plant to grow well and not enough to cause too rapid development of "weed." It is a trite saying among farmers of the South that "a dry May produces a clean crop." This peculiar climatic condition that generally prevails in the cotton region during the month of May, may, in a large measure, enable the farmer to clean his crop, but the equally important fact of deep root penetration, already referred to, must not be overlooked.

In studying the climatology of any section of country, to determine its adaptability to the growth of certain kinds of plants, it is not well to draw definite conclusions alone from annual precipitations, nor even from the amounts that fall in each season; although these results are very important and should be carefully considered in their proper connections. But when we remember what great changes take place in the condition of the plant within thirty days, valuable conclusions may be drawn by comparing the month of one year with that of another. In this connection the following questions may be appropriately asked: When does the rain fall in largest amounts; in spring, summer, autumn, or winter? Is there a dry season and a wet season? But the answers to these questions alone

will not bring out all the special points of advantage or disadvantage in studying the adaptation of any section of the country to the special cultivation of certain kinds of plants. The cotton is a peculiar plant in respect to its demands for moisture, and one month's time in the middle of spring may decide its fate for or against producing a good yield of lint. Experience has taught that the rains must be distributed during the spring and early portion of summer while the plant is young and while it is in its blooming state, so as to keep the soil in the condition best suited to yield up its food elements to the rapid demands of the growing limbs, leaves, and buds; but at the same time there must be ample sunshine, because the cotton plant loves the sunlight. The fact must not be lost sight of either, as has been previously stated, that the soil must not be so moist for any length of time during April and May as to cause too rapid multiplication of surface roots. The depth of the soil controls, to a large degree, the quantity of moisture that will be retained in it after a season of rains, and it is therefore of great importance that the land should be deeply broken and well pulverized during the preparatory season in February and March; and after the plant is up above the soil the surface should not be allowed to harden and bake into a crust but should be often stirred. The pulverization of the soil will enable the small particles of earth to take up the moisture floating through the atmosphere during the night and early morning and thus add a new and steady supply for the roots to absorb. Circulation is absolutely necessary for good results. An excess of water prevents that due admixture and division of the ingredients so important for the healthy growth of the plants. It also diminishes the fertilizing properties of the manures that may be added to the soil when the seed are planted. The excess of water also lowers the temperature of the soil, and it prevents free circulation of air so necessary for the healthy condition of the roots. The cotton plant is particularly averse to excessive rains and a saturated atmosphere and soil, and will not thrive well under such conditions. Whenever these conditions prevail during the spring or the growing season the powers of the plant to produce an abundance of well-matured fiber will be greatly curtailed.

The cotton plant loves the sun, and during its entire life must have an extra quantity of warm rays. It thrives best in that climate where the atmosphere is well warmed by the almost vertical rays of the sun. In discussing the temperature phase of this subject this fact must be well borne in mind. Observation extended over a wide field of experience has proven this proposition to be indisputable. Seven months from the planting of the seeds until picking is about completed are required for the full and satisfactory development of the cotton in all its functions. These seven months must contain a large share of sun-

shine and be free from heavy frosts. Table XXV, at the end of this work, will show that the percentage of cloudy days is small when compared with the amount of clear weather. From this table we learn that on an average, in the middle section of the cotton belt, 46 days out of 100 produce cloudy weather, while 54 days are entirely clear. This table also shows that 32 days in 100 throughout the middle portions of the belt are likely to produce rain during the spring of the year.

Table XII, minimum temperatures, page 34, proves that during the months of April and May the weather is seldom so cold as to entirely destroy the tender cotton plant just after it reaches the surface of the ground when it is most susceptible to the influence of cold. As has already been stated, the seed is planted about the middle of April in the southern portions of the belt, and the plant comes above the surface some time during the first part of May. The table herewith given proves that very rarely does the thermometer record temperatures lower than 33°. The maximum temperature sometimes goes as high as 98°, but the range is generally between 80° and 95°, thus supplying a large percentage of heat rays for the warmth of the soil. As far south as Mobile, during a period of 21 years, the temperature ranged above 40° as often as 18 years and above 45° as often as 10 years. At Augusta, Ga., in the middle area of the cotton belt, the minimum temperature, throughout a period of 19 years, ranged above 40° nine times, and fell below 35° only five times during the period covered by the records. At Vicksburg, also in the middle section, the minimum temperature, in a period of 19 years, ranged above 40° fifteen times, and fell below 35° only twice. At Montgomery, Ala., in the central belt, and on the edge of the great prairie region, the minimum temperature ranged above 40° 13 years out of a record of 19 years. These facts indicate a remarkably fair season for the planting of the seed, and show that the soil is not so chilled as to prevent the rapid germination of the plant. It is therefore customary among the farmers throughout the extent of this southern area to plant a week, and in some places two weeks, earlier than in that portion of the cotton belt located north of Montgomery and Augusta.

By the first of May cotton planting has become general throughout the entire area of the cotton belt. After the close of the second week in May frost is not likely to occur, and, although there may be a few cool nights, the cotton plant in its young, tender condition, stands a very fair chance in all sections of the country under consideration. By a glance at the table of temperatures for May we will see that the mean minimum ranges above 52° at all stations, and at the majority it is above 60°. The minimum temperature, even at the extreme northern stations, never falls below 35°, and at twenty-five out of thirty-one stations furnishing continuous records, the minimum is never lower than 40°.

At Memphis, Tenn., one of the stations situated in the northern limits of the cotton region, and around which cotton is quite successfully cultivated, the minimum temperature during a period of twenty years ranged above 45° fifteen years, and did not fall below 40° a single time during those twenty years. When we couple with this fact the frequency with which the thermometer recorded temperatures above 90° (thirteen times) during this long period, we can readily understand why it is safe to put in the crop even as early as the last week in April. This is not true with regard to the section of country immediately surrounding Knoxville, Tenn., another one of the northern section stations. On account of the difference in altitude between Memphis and Knoxville, although there is so little in latitude, the climate of the latter place is more severe in May than at the former, and consequently the season is so much shortened the growth of the cotton there is not so certain. At Knoxville the minimum temperature, in a period of twenty-one years, fell too near the frost limits eleven out of the twenty-one years, and of the remaining years only five gave minimum results above 45°.

Table XIII, page 36, giving by comparison the minima and the mean minima temperatures, will be interesting in this connection. The latter represents what I have termed plant temperatures, because they are apt to occur each year, while the minima may not occur oftener than once in several years. I have selected for this table four stations in the northern part of the cotton belt, five in the central portion, and four in the southern section. These stations are so distributed as to give average results for the entire belt. It will be noticed that where the mean minimum temperature is below 55° the growth of cotton is not entirely successful, while in those portions of the region where cotton is cultivated on a large scale the mean minimum temperature ranges from 55° to 65° in April. This table, to bring out its most important features, should be compared with the map of the cotton area, Chart VII, and also compared with the table of last frosts furnished elsewhere. The first figures represent the minima temperatures and the second figures are given for the mean minima temperatures:

TABLE XII.—*Temperature for April and May at stations in the cotton region.*

NORTHERN SECTION.

| Stations. | Monthly mean. | | Mean max. | | Mean min. | | Maximum. | | | | Minimum. | | | | April. | | May. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | April. | | May. | | April. | | May. | | | | | |
| | April. | May. | April. | May. | April. | May. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year | Range between max. and min. | Range between mean max. and mean min. | Range between max. and min. | Range between mean max. and mean min. |
| | ° | ° | ° | ° | ° | ° | | | | | | | | | ° | ° | ° | ° |
| Atlanta, Ga | 61.6 | 68.9 | 71.0 | 78.3 | 52.2 | 59.6 | 88 | 1887 | 91 | 1879, '81 | 25 | 1881 | 57 | 1889, '91 | 63 | 18.8 | 34 | 18.7 |
| Charlotte, N. C | 59.9 | 68.8 | 70.4 | 78.9 | 49.4 | 58.7 | 91 | 1888 | 95 | 1889 | 28 | 1881 | 38 | 1889, '91 | 63 | 21.0 | 57 | 20.2 |
| Chattanooga, Tenn | 62.7 | 68.9 | 74.2 | 79.6 | 52.2 | 58.2 | 89 | 1889, '91 | 93 | 1879 | 25 | 1881 | 40 | 1888, '89 | 64 | 23.0 | 53 | 21.4 |
| El Paso, Tex | 64.3 | 73.1 | 80.1 | 88.9 | 48.4 | 57.3 | 98 | 1879 | 105 | 1883 | 29 | 1882 | 39.5 | 1884 | 69 | 31.7 | 65.5 | 31.6 |
| Fort Davis, Tex | 60.7 | 68.4 | 75.1 | 82.9 | 46.3 | 54.0 | 95 | 1879 | 101 | 1881 | 25 | 1882 | 40 | 1880, '84 | 70 | 28.8 | 61 | 28.9 |
| Fort Elliott, Tex | 57.1 | 69.7 | 70.9 | 77.3 | 43.4 | 52.1 | 96 | 1880 | 98 | 1889 | 20 | 1881, '86 | 35 | 1885, '89 | 76 | 27.5 | 63 | 25.2 |
| Fort Smith, Ark | 62.8 | 68.9 | 74.0 | 80.3 | 51.7 | 57.6 | 91 | 1887 | 98 | 1886 | 30 | 1886, '87 | 40 | 1889 | 61 | 22.3 | 58 | 22.7 |
| Knoxville, Tenn | 58.0 | 66.7 | 68.3 | 77.6 | 47.7 | 55.8 | 89 | 1887 | 94 | 1877 | 24 | 1875, '81 | 36 | 1888, '89 | 65 | 20.6 | 58 | 21.8 |
| Little Rock, Ark | 63.5 | 70.2 | 73.3 | 79.5 | 53.7 | 60.9 | 94 | 1880 | 93 | 1886 | 28 | 1886 | 44 | 1883, '85, '89 | 66 | 19.6 | 49 | 18.6 |
| Memphis, Tenn | 62.5 | 70.3 | 71.5 | 79.4 | 53.4 | 61.1 | 88 | 1882, '83 | 96 | 1879 | 27 | 1881 | 41 | 1883, '85 | 61 | 18.1 | 55 | 18.3 |
| Nashville, Tenn | 59.6 | 67.9 | 69.5 | 78.2 | 49.7 | 57.5 | 90 | 1872 | 93 | 1879 | 26 | 1875 | 37 | 1877, '88, '90 | 64 | 19.8 | 56 | 20.7 |
| Means | 61.0 | 69.2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

MIDDLE SECTION.

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auburn, Ala | 63.4 | 71.4 | 72.7 | 80.9 | 54.0 | 61.9 | 86 | 1881 | 93 | 1881 | 27 | 1881 | 42 | 1890 | 59 | 18.2 | 51 | 19.0 |
| Augusta, Ga | 64.6 | 72.5 | 75.3 | 83.4 | 53.8 | 61.6 | 93 | 1885, '87 | 100 | 1878 | 29 | 1887 | 42 | 1877, '91 | 64 | 21.5 | 58 | 21.8 |
| Charleston, S. C | 64.4 | 72.3 | 71.9 | 79.5 | 56.9 | 65.1 | 88 | 1888, '90 | 96 | 1889 | 32 | 1881 | 47 | 1876 | 56 | 15.0 | 49 | 14.4 |
| Hatteras, N. C | 56.9 | 67.2 | 63.2 | 72.5 | 50.6 | 61.8 | 76 | 1885, '86, '87 | 88 | 1881 | 31 | 1875, '81 | 43 | 1876 | 45 | 12.6 | 45 | 10.7 |
| Kittyhawk, N. C | 56.0 | 65.9 | 62.7 | 72.9 | 49.3 | 58.9 | 92 | 1888 | 94 | 1889 | 29 | 1881 | 42 | 1876, '77 | 63 | 13.4 | 52 | 14.0 |
| Montgomery, Ala | 65.8 | 73.4 | 76.0 | 83.8 | 55.6 | 63.0 | 90 | 1880 | 98 | 1875 | 30 | 1881 | 44 | 1883, '89 | 60 | 20.4 | 54 | 20.8 |
| Palestine, Tex | 66.7 | 71.6 | 76.3 | 81.2 | 57.0 | 62.0 | 88 | 1887 | 92 | 1886, '87 | 36 | 1886, '91 | 46 | 1887, '91 | 52 | 19.3 | 46 | 19.2 |
| Shreveport, La | 67.3 | 74.0 | 77.4 | 84.0 | 57.3 | 64.0 | 96 | 1887 | 101 | 1875, '86 | 32 | 1881 | 47 | 1876, '77 | 64 | 20.1 | 54 | 20.0 |
| Vicksburg, Miss | 65.9 | 72.9 | 75.4 | 82.9 | 56.7 | 63.4 | 92 | 1887 | 95 | 1874, '77 | 31 | 1881 | 46 | 1877 | 61 | 18.7 | 49 | 19.5 |
| Wilmington, N. C | 60.5 | 67.2 | 69.3 | 76.6 | 51.7 | 57.7 | 90 | 1880 | 97 | 1889 | 28 | 1875 | 38 | 1876 | 62 | 17.6 | 59 | 18.9 |
| Means | 63.2 | 70.8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brownsville, Tex | 74.4 | 79.3 | 82.4 | 86.2 | 66.5 | 72.3 | 98 | 1886 | 99 | 1877 | 43 | 1881 | 49 | 1877 | 55 | 15.9 | 50 | 13.9 |
| Cedar Keys, Fla | 69.8 | 75.5 | 76.1 | 81.9 | 63.4 | 69.0 | 88 | 1880 | 91 | 1880, '81 | 38 | 1881 | 50 | 1883 | 50 | 12.7 | 41 | 12.9 |
| Galveston, Tex | 70.0 | 76.1 | 75.1 | 81.5 | 64.9 | 70.7 | 85 | 1878 | 91 | 1875, '77 | 43 | 1886 | 54 | 1876 | 42 | 10.2 | 67 | 10.8 |
| Jacksonville, Fla | 68.9 | 72.0 | 78.0 | 83.6 | 59.7 | 60.4 | 91 | 1880 | 99 | 1878 | 34 | 1891 | 48 | 1877 | 57 | 18.3 | 51 | 23.2 |
| Mobile, Ala | 67.1 | 74.2 | 75.5 | 83.2 | 58.7 | 65.1 | 90 | 1881, '83 | 98 | 1878 | 32 | 1881, '91 | 46 | 1889 | 58 | 16.8 | 52 | 18.1 |
| New Orleans, La | 68.9 | 74.9 | 76.1 | 82.0 | 61.8 | 67.7 | 88 | 1889 | 92 | 1877 | 38 | 1881 | 53 | 1891 | 50 | 14.3 | 39 | 14.3 |
| Pensacola, Fla | 67.7 | 73.4 | 74.6 | 80.1 | 60.8 | 66.7 | 92 | 1887 | 93 | 1881 | 34 | 1881, '91 | 47 | 1883, '89 | 58 | 13.8 | 46 | 13.4 |
| Rio Grande City, Tex | 74.2 | 80.9 | 87.8 | 91.5 | 60.5 | 70.3 | 109 | 1878 | 112 | 1879 | 43 | 1881 | 49 | 1877 | 66 | 27.3 | 63 | 21.2 |
| San Antonio, Tex | 69.4 | 74.8 | 79.7 | 84.7 | 59.2 | 64.8 | 96 | 1880 | 104 | 1879 | 35 | 1886 | 46 | 1889 | 61 | 20.5 | 58 | 19.9 |
| Savannah, Ga | 66.6 | 73.2 | 74.7 | 81.4 | 57.4 | 65.1 | 89 | 1873, '87 | 98 | 1878 | 33 | 1881 | 48 | 1877 | 56 | 17.3 | 50 | 16.3 |
| Means | 69.7 | 75.4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

TABLE XIII.—*Minima and mean minima temperatures at selected stations.*

| Stations. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | 1886. | 1887. | 1888. | 1889. | 1890. | 1891. | Average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Atlanta..... | 30 | 36 | 25 | 43 | 37 | 35 | 36 | 32 | 36 | 40 | 34 | 42 | 28 | 34.9 |
| | 50.2 | 55 | 50 | 56 | 52 | 50.2 | 51.5 | 51.8 | 50.3 | 54.1 | 51.8 | 53 | 52.6 | 52.2 |
| Fort Smith. | ..... | ..... | ..... | ..... | 37 | 35 | 40 | 30 | 30 | 42 | 43 | 39 | 28 | 36.0 |
| | ..... | ..... | ..... | ..... | 51.2 | 48.9 | 52.2 | 49.5 | 50.3 | 55.4 | 54.1 | 53 | 50.6 | 51.7 |
| Knoxville.. | 25 | 30 | 24 | 36 | 33 | 31 | 29 | 29 | 29 | 36 | 32 | 35 | 29 | 30.6 |
| | 44.8 | 49.5 | 44.7 | 51 | 58.4 | 45.7 | 46.9 | 49.5 | 46.3 | 49.5 | 48.6 | 50.7 | 49.3 | 48.8 |
| Memphis... | 36 | 39 | 27 | 41 | 39 | 41 | 35 | 34 | 38 | 43 | 41 | 39 | 33 | 37.4 |
| | 51.4 | 53.4 | 50.6 | 56.5 | 54.4 | 51.8 | 55.1 | 53.2 | 53.7 | 55.8 | 54.4 | 53.4 | 54.9 | 53.7 |
| Kittyhawk . | 31 | 33 | 29 | 38 | 36 | 38 | 35 | 39 | 33 | 39 | 41 | 37 | 36 | 36.5 |
| | 45.4 | 50.3 | 48.1 | 51.8 | 51.2 | 45.8 | 46.8 | 48.6 | 40.4 | 47 | 46.4 | 51.5 | 48.6 | 48.4 |
| Charleston . | 39 | 39 | 32 | 46 | 45 | 43 | 43 | 39 | 33 | 50 | 42 | 47 | 38 | 42.1 |
| | 56 | 58.9 | 52.7 | 59.9 | 58.5 | 56.2 | 56.7 | 55.5 | 55.5 | 58.9 | 55.1 | 57.3 | 57.9 | 56.1 |
| Montgomery | 36 | 40 | 30 | 48 | 41 | 43 | 38 | 36 | 40 | 44 | 41 | 44 | 31 | 39.4 |
| | 53.9 | 59.2 | 54 | 59.1 | 56.7 | 54.2 | 53.6 | 54.9 | 54.4 | 57.9 | 55.1 | 56.8 | 55.3 | 55.8 |
| Palestine... | ..... | ..... | ..... | 43 | 44 | 38 | 47 | 36 | 40 | 42 | 50 | 46 | 36 | 42.2 |
| | ..... | ..... | ..... | 59 | 56.5 | 53.6 | 58.8 | 55.4 | 55.4 | 61.3 | 58.4 | 56.7 | 54.9 | 57.0 |
| Vicksburg.. | 39 | 41 | 31 | 47 | 44 | 44 | 42 | 35 | 43 | 46 | 46 | 51 | 33 | 41.7 |
| | 55.4 | 59.4 | 56.6 | 60.3 | 57.5 | 54.7 | 58.7 | 54.9 | 55.2 | 58.7 | 56.5 | 59 | 56.4 | 57.2 |
| Brownsville | 50 | 46 | 43 | 48 | 58 | 47 | 59 | 45 | 51 | 61 | 56 | 53 | 50 | 51.3 |
| | 67 | 69.2 | 64.7 | 66.2 | 67.6 | 64.1 | 69 | 64.4 | 65.7 | 68.4 | 67.2 | 67.7 | 63.3 | 66.7 |
| Jacksonville | 39 | 42 | 37 | 56 | 52 | 47 | 47 | 44 | 38 | 49 | 44 | 47 | 34 | 44.3 |
| | 57.5 | 62.6 | 58.4 | 64.2 | 64 | 60.6 | 59.9 | 59.2 | 58.2 | 61.9 | 57.3 | 60.4 | 58.2 | 60.2 |
| Mobile ..... | 40 | 42 | 32 | 49 | 47 | 43 | 40 | 37 | 41 | 50 | 44 | 48 | 32 | 42.0 |
| | 57.1 | 62 | 57.5 | 62.5 | 61.1 | 58.5 | 59.1 | 56.2 | 55.9 | 60.9 | 58 | 60.5 | 57.1 | 58.9 |
| N. Orleans.. | 46 | 49 | 38 | 56 | 51 | 50 | 52 | 41 | 48 | 56 | 54 | 56 | 41 | 49.0 |
| | 58.7 | 64.8 | 59.5 | 66.1 | 64.7 | 61 | 64.9 | 58.3 | 60.1 | 63.3 | 61.4 | 62.5 | 60.9 | 62.0 |

## SOIL TEMPERATURES.

Soil temperatures furnish interesting data for comparison with air temperatures in the study of the subject of the climatology of plant growth. These temperatures show how much below the surface of the earth the heat of the sun has penetrated, and the power certain soils have for retaining the heat required for all the demands of the germinating seed. It is to be regretted that so little work has been done in this connection and that so little data can be secured relating to the temperature of the soil. The observations at Auburn and Uniontown, Ala., from which records Table XV has been made, cover so limited a period of time, the conclusions drawn in connection with the subject under consideration can only be general.

In the discussion of this portion of our subject it may not be amiss to make a comparison between what has been determined to be the germinating temperature of seeds and the general temperature conditions of the soil during the planting season of April and May. The seeds that have been selected for this purpose, it is true, are different in character to that of cotton, and it may be possible that they will germinate at temperatures several degrees lower than will cotton seed, but I am in hopes for the purposes we have in view they will serve our object. No experiments that the writer is aware of have been made to determine the germinating temperature of cotton seed. Experiments are now under way at the Alabama Agricultural Experiment Station at Auburn to solve this interesting problem.

The minimum temperature below which it is said seeds will not germinate has been given by Haberlandt as 4.75° C., or 40.6° F. Some seeds, however, may be made to start even below this temperature. Between the maximum and minimum germinating temperatures there is an optimum at which germination begins most speedily, and our table of soil temperatures shows that this point is reached very often. As a means of comparison I give Table XIV, taken from Sach's Botany, containing the germinating temperatures of certain well known plants.

TABLE XIV.—*Germinating temperatures.*

| | Maximum. | Minimum. | Optimum. |
|---|---|---|---|
| | ° F. | ° F. | ° F. |
| Barley | 99.5 | 41.0 | 83.7 |
| Flax | ..... | 35.0 | 81.3 |
| Indian corn | 115.2 | 48.8 | 92.7 |
| Lepium sativum | ..... | 35.0 | 81.0 |
| Pea | ..... | 43.0 | 78.8 |
| Pumpkin | 115.2 | 56.7 | 92.7 |
| Squash | 115.0 | 51.8 | 92.0 |
| Sunflower | ..... | ..... | 88.7 |
| Watermelon | ..... | ..... | 99.5 |
| Wheat | 107.6 | 41.0 | 82.4 |

TABLE XV.—*Soil and air temperatures at Auburn and Uniontown, Alabama.*

SOIL TEMPERATURES.

April.

| Years. | 1 inch. | | | 3 inches. | | | 6 inches. | | | 12 inches. | | | 24 inches. | | | 36 inches. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. |
| Auburn. | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| 1889 | 85.5 | 50.0 | 68.6 | 83.5 | 51.0 | 68.1 | 79.9 | 53.0 | 66.6 | 73.0 | 56.5 | 64.1 | 68.5 | 59.0 | 63.1 | 64.5 | 57.5 | 60.9 |
| 1890 | 83.5 | 48.0 | 68.8 | 82.0 | 50.0 | 67.6 | 75.5 | 52.5 | 61.8 | 75.0 | 56.0 | 66.0 | 69.5 | 60.0 | 64.2 | 67.0 | 60.0 | 62.8 |
| 1891 | 87.5 | 34.0 | 67.7 | 86.0 | 37.5 | 66.5 | 83.0 | 40.0 | 65.0 | 76.0 | 43.5 | 62.5 | 69.5 | 51.0 | 61.9 | 66.0 | 54.0 | 60.0 |
| Uniontown. | | | | | | | | | | | | | | | | | | |
| 1889 | 69.0 | 51.0 | 61.4 | 67.0 | 53.0 | 61.3 | 66.0 | 55.0 | 61.2 | 64.5 | 57.0 | 66.0 | 63.5 | 57.0 | 60.4 | 62.5 | 56.5 | 59.7 |
| 1890 | 72.5 | 51.5 | 63.1 | 69.5 | 54.5 | 62.3 | 67.0 | 57.0 | 62.3 | 65.5 | 59.0 | 62.3 | 64.0 | 59.0 | 62.0 | 63.5 | 59.0 | 61.6 |
| 1891 | 74.0 | 38.5 | 62.3 | 70.0 | 41.5 | 61.5 | 68.5 | 46.5 | 61.0 | 67.0 | 50.5 | 60.6 | 65.5 | 54.0 | 59.9 | 64.0 | 50.0 | 59.4 |

May.

| Years. | 1 inch. | | | 3 inches. | | | 6 inches. | | | 12 inches. | | | 24 inches. | | | 36 inches. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. | Max. | Min. | Mean. |
| Auburn. | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| 1888 | 91.0 | 58.5 | 74.0 | 90.5 | 59.5 | 74.0 | 86.0 | 63.5 | 73.0 | 81.5 | 65.0 | 71.5 | 75.5 | 67.5 | 71.5 | 71.5 | 66.5 | 68.0 |
| 1889 | 92.0 | 52.0 | 77.3 | 90.0 | 55.0 | 77.1 | 86.5 | 58.0 | 75.7 | 81.5 | 61.0 | 72.0 | 70.5 | 64.0 | 71.7 | 73.0 | 63.0 | 68.9 |
| 1890 | 94.5 | 52.0 | 76.2 | 90.0 | 54.0 | 75.5 | 86.0 | 59.0 | 73.9 | 81.0 | 62.0 | 72.0 | 75.0 | 66.0 | 70.6 | 71.0 | 66.5 | 68.6 |
| 1891 | 95.0 | 56.5 | 76.4 | 91.5 | 56.5 | 76.2 | 89.0 | 57.5 | 74.9 | 79.5 | 61.5 | 71.5 | 74.0 | 66.0 | 70.6 | 72.0 | 66.0 | 68.2 |
| Uniontown. | | | | | | | | | | | | | | | | | | |
| 1889 | 77.5 | 56.0 | 68.8 | 74.5 | 57.0 | 68.4 | 73.5 | 59.5 | 68.0 | 71.5 | 61.0 | 67.4 | 70.0 | 62.0 | 66.3 | 68.0 | 62.0 | 64.9 |
| 1890 | 75.5 | 56.0 | 69.0 | 74.0 | 58.5 | 68.2 | 72.5 | 62.0 | 68.1 | 71.5 | 64.0 | 68.0 | 70.0 | 65.0 | 67.4 | 69.0 | 64.5 | 66.5 |
| 1891 | 70.5 | 55.5 | 69.7 | 74.0 | 59.0 | 68.7 | 71.5 | 63.5 | 68.2 | 71.0 | 65.0 | 68.2 | 70.0 | 66.0 | 67.4 | 68.5 | 64.5 | 67.1 |

TABLE XV.—*Soil and air temperatures at Auburn and Uniontown*—Continued.

AIR TEMPERATURES.

| Years. | April. | | | May. | | |
|---|---|---|---|---|---|---|
| | Max. | Min. | Mean. | Max. | Min. | Mean. |
| Auburn. | ° | ° | ° | ° | ° | ° |
| 1889 | 84.0 | 41.0 | 67.5 | 90.0 | 41.0 | 72.9 |
| 1890 | 86.0 | 45.0 | 65.6 | 87.0 | 48.0 | 72.4 |
| 1891 | 85.0 | 30.0 | 64.5 | 90.0 | 46.0 | 72.4 |
| Uniontown. | | | | | | |
| 1889 | 82.0 | 38.0 | 62.5 | 89.0 | 45.0 | 70.1 |
| 1890 | 83.0 | 42.0 | 64.7 | 88.5 | 42.0 | 71.2 |
| 1891 | 83.0 | 30.0 | 63.5 | 89.0 | 45.0 | 69.6 |

The maximum temperature for Uniontown, it will be noticed, is lower than that for Auburn. This may be explained on the ground that the soil at the former place is more moist than is the soil at the latter place. The predominating soil at Auburn is of a sandy, open nature that readily gives up the moisture it receives from the rains and dews under the influence of the sun's rays, while the soil at Uniontown is calcareous in composition and receives and retains the water much longer and hence keeps down the temperature of the soil.

It is thus observed that under the influences of the occurrence of high temperatures and the generally prevailing fine weather after the 20th of April, the soil has become rapidly warmed and the seed quickly germinates and is generally very well started above the surface of the ground by the middle of May. The seed usually takes from five to twenty days to come up, if the soil is kept comparatively warm and the rains have been sufficient to supply the needed moisture. When the young plant is three or four weeks old the crop is thinned out to a stand. This takes place after the third or fourth leaf appears. In planting, sufficient seed are put in the drill to insure a good stand, and when "chopping out" is completed only so many plants are left standing in the field as will permit the roots of one to spread without interfering with those of another. This gives also ample room for the expansion of the limbs of the plants, so that the sunlight may penetrate to all the leaves, and thus insure the development of flowers and the rapid opening of the bolls that contain the fiber.

## V.—THE GROWING PERIOD OF THE PLANT, AND ITS WEATHER CONDITIONS.

This period might be properly termed the season from "chopping out" to the appearance of the first boll. In the central portions of the cotton belt this time is generally from the first of June to the first of August. The first bloom opens early in June and the first boll forms early in August. During this period in the life of the plant

there must be a large supply of sunshine, and only so much moisture as will furnish the plant with what it needs, and at the same time not make the soil so damp as to cause too rapid multiplication of surface roots nor cause too great a growth of what farmers term "weed," that is, rapid development of stalk and branches to the detriment of flowers and fruit. The atmosphere must not be very dry, but there must be that degree of moisture present that will readily become absorbed by the soil at night in the shape of dew, with occasional good showers through the season. The surface soil must be often stirred during this growing period so as to permit of free circulation of air through the soil, the penetration of the warm sun's rays, and the condensation of moisture from the atmosphere as it circulates over the soft land at night, and in the cool early morning. In this manner much of the moisture required by the roots will be secured, although rains may not be frequent; and at the same time an ample supply of sunshine and warmth will give the young buds vigor, and cause them to open promptly and bring forth healthy, well-developed bolls.

Experience has shown that the above conditions are required during the growing season to produce the best results in cotton culture. Now let us see what are the actual climatic conditions prevailing in the cotton belt during these months of June and July, and note in what respects they comply with the requirements and in what points they fail. To bring out these features the following tables, taken from the files of the Weather Bureau, have been prepared. A careful examination of these tables will present the striking fact that the weather conditions, during these two months, come very near filling all the requirements of the perfect cotton culture. It is true that some seasons are very unfavorable and poor crops are the result, but in the study of this question of climatology we must be governed by conclusions drawn from data covering a long term of years rather than confining our deductions to isolated years only.

During the months of June and July rains are not ordinarily heavy, and floods occur only at long intervals. Table XVI shows that the greatest normal rainfall is 6.83 inches for June at Cedar Keys, Fla., and for July it is 8.68 inches at the same place. The largest number of rainy days that occur during the two months usually take place at stations along the Atlantic and Gulf coasts. At stations in the interior the rain is not so frequent, but with the exception of some of the stations in Texas, there is never less than ten normal rainy days in each month, thus furnishing ample moisture for all the demands of the cotton plant while in its blooming season. Much rain during this period is decidedly injurious to the plant because the flowers are so singularly constituted that if water accumulates in the cup formed by the petals and sepals rapid decay will take place,

caused by fermentation of the gelatinous substance generated at the base of the flowers, and the forms will shed off and the yield of the plant be correspondingly decreased. These flowers open in the early morning, just after the sun rises above the horizon, and remain expanded to the sun's rays until late in the evening, when the petals close and remain so until next morning when they open again.

At this stage of their development the color changes from a delicate cream to a light red. At the close of this day the petals fall off, leaving a small boll surrounded by the green sepals. Now, if the rains are frequent during this period the petals have their sensitive organisms greatly dulled, and the absence of the sunlight, so necessary for their activity, causes them to stick to the forming boll and decay rapidly follows. Much cloudy weather during this period is almost as injurious as continual rains, for the reasons already stated —the cotton plant is a sun plant. Now, a glance at our tables will show that the normal conditions throughout the cotton belt are very favorable for the growth of such a peculiarly delicate plant. If the season during April and May has been propitious the tap root is deep in the soil at this stage of the plant, and the supply of moisture brought up from below is amply sufficient for all demands if a shower falls occasionally.

This plant can stand a much longer drought while blooming than almost any other vegetation, and hence the fall of rain should not be more frequent than once in three or four days, and the showers should be very light, permitting as much as possible the largest amount of sunshine. In Table XIX, probability of rainy days, page 45, it will be noticed that the number of days on which rain is apt to fall during these two months does not exceed 51 per cent. at any point in the entire region of the cotton belt, and at most places it generally does not exceed 40 per cent. The average number of sunny days during June and July is 56 per cent. At many of the stations, however, the percentage of perfectly clear days is greater than that given above for the entire region. For instance, at Memphis, Tenn., it is 59 per cent.; at Vicksburg, Miss., it is 68 per cent.

In Table XVII, June and July temperatures, special attention is called to the close uniformity existing between the two months, and also how near the same temperature is furnished by all the stations occupying the southern portion of the cotton belt. This is found to be true also when the stations of each of the other two sections are compared with each other.

During this period of its growth the plant is forging ahead rapidly, making leaves and roots, and towards the middle of June flowers are opening in all directions of the cotton belt under the warm, invigorating influence of the atmosphere so favorably prevailing all over the country.

TABLE XVI.—*Precipitation for June and July in the cotton belt.*

| Stations. | Normal precipitation. | | Average number of rainy days. | | Maximum precipitation. | | Month and year. | | Minimum precipitation. | | Month and year. | | Average number of cloudless days. | | Average number of partly cloudy days. | | Average number of cloudy days. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | June. | July. | June. | July. | June. | July. | June. | July. | June. | July. | June. | July. | June. | July. | June. | July. |
| | *Inches.* | *Inches.* | | | *Inches.* | *Inches.* | | | *Inches.* | *Inches.* | | | | | | | | |
| Charlotte, N. C | 4.67 | 5.86 | 12.0 | 12.2 | 11.04 | 8.64 | 1886 | 1879 | 0.52 | 1.68 | 1890 | 1888 | 8.7 | 7.8 | 13.3 | 14.7 | 8.0 | 8.5 |
| Hatteras, N. C | 4.80 | 6.33 | 10.6 | 11.1 | 11.91 | 10.51 | 1889 | 1884 | 0.63 | 2.21 | 1882 | 1879 | 10.2 | 11.3 | 6.0 | 13.4 | 13.8 | 6.3 |
| Kittyhawk, N. C | 4.81 | 5.81 | 10.8 | 11.4 | 10.97 | 15.36 | 1877 | 1882 | 1.44 | 0.94 | 1879 | 1885 | 10.6 | 9.7 | 13.5 | 15.3 | 5.9 | 6.0 |
| Wilmington, N. C | 5.94 | 7.27 | 12.0 | 15.1 | 12.44 | 21.12 | 1870 | 1886 | 2.87 | 1.95 | 1872 | 1875 | 8.7 | 8.8 | 14.4 | 14.4 | 7.9 | 7.8 |
| Charleston, S. C | 5.08 | 6.95 | 11.6 | 12.4 | 14.98 | 13.74 | 1876 | 1874 | 1.20 | 1.05 | 1891 | 1875 | 8.1 | 9.0 | 13.4 | 14.5 | 8.5 | 7.5 |
| Atlanta, Ga | 4.41 | 4.63 | 12.0 | 10.0 | 10.73 | 14.11 | 1884 | 1887 | 1.12 | 0.56 | 1890 | 1881 | 8.0 | 8.8 | 14.6 | 14.9 | 7.4 | 7.3 |
| Augusta, Ga | 4.24 | 5.17 | 11.3 | 11.2 | 9.05 | 10.10 | 1886 | 1889 | 1.21 | 1.79 | 1879 | 1888 | 8.1 | 8.8 | 14.7 | 14.6 | 7.2 | 7.6 |
| Savannah, Ga | 6.75 | 5.34 | 13.1 | 12.8 | 18.79 | 10.14 | 1876 | 1874 | 0.91 | 0.82 | 1881 | 1888 | 7.3 | 7.9 | 14.9 | 16.2 | 7.2 | 6.9 |
| Cedar Keys, Fla | 6.83 | 8.08 | 11.3 | 14.5 | 10.98 | 11.72 | 1885 | 1886 | 1.69 | 4.11 | 1881 | 1888 | 6.2 | 7.7 | 16.6 | 14.0 | 7.2 | 9.3 |
| Jacksonville, Fla | 6.03 | 6.36 | 14.8 | 16.7 | 16.75 | 14.97 | 1871 | 1886 | 1.25 | 0.14 | 1879 | 1875 | 7.7 | 8.8 | 15.0 | 16.1 | 7.3 | 6.1 |
| Pensacola, Fla | 5.85 | 6.55 | 12.4 | 14.7 | 14.11 | 13.68 | 1887 | 1890 | 2.21 | 2.20 | 1890 | 1888 | 10.0 | 9.1 | 14.6 | 15.8 | 5.4 | 6.1 |
| Chattanooga, Tenn | 4.37 | 3.72 | 14.3 | 13.1 | 9.20 | 6.18 | 1884 | 1891 | 1.69 | 2.06 | 1879 | 1883 | 8.8 | 8.9 | 14.4 | 14.6 | 6.1 | 6.7 |
| Knoxville, Tenn | 4.29 | 4.37 | 13.3 | 12.7 | 6.68 | 8.59 | 1872 | 1884 | 1.99 | 2.12 | 1879 | 1877 | 8.4 | 10.2 | 15.0 | 14.5 | 6.6 | 6.3 |
| Memphis, Tenn | 5.00 | 3.29 | 11.0 | 10.0 | 18.16 | 6.22 | 1877 | 1877 | 1.04 | 0.47 | 1887 | 1874 | 9.2 | 11.6 | 14.7 | 13.8 | 6.1 | 5.6 |
| Nashville, Tenn | 4.34 | 4.54 | 11.2 | 10.5 | 7.69 | 9.43 | 1880 | 1878 | 2.23 | 0.46 | 1890 | 1890 | 6.4 | 8.9 | 17.1 | 16.1 | 6.5 | 6.0 |
| Auburn, Ala | 5.28 | 4.37 | 10.2 | 10.0 | 11.52 | 21.09 | 1884 | 1887 | 1.89 | 2.38 | 1855 | 1856 | 6.4 | 7.5 | 14.0 | 16.6 | 9.6 | 6.9 |
| Mobile, Ala | 6.06 | 6.60 | 12.9 | 15.1 | 13.56 | 13.36 | 1888 | 1872 | 2.35 | 2.77 | 1879 | 1881 | 8.1 | 7.0 | 15.0 | 16.3 | 6.9 | 7.7 |
| Montgomery, Ala | 4.92 | 4.24 | 12.3 | 12.0 | 11.08 | 7.54 | 1873 | 1885 | 1.94 | 0.87 | 1875 | 1883 | 7.7 | 7.5 | 13.5 | 15.8 | 8.8 | 7.7 |
| Vicksburg, Miss | 4.35 | 4.15 | 10.9 | 11.3 | 9.83 | 10.19 | 1889 | 1882 | 0.40 | 1.58 | 1882 | 1886 | 9.3 | 9.7 | 15.0 | 15.1 | 5.7 | 6.2 |
| Little Rock, Ark | 4.39 | 3.88 | 11.6 | 10.0 | 9.28 | 9.23 | 1880 | 1891 | 1.96 | 1.18 | 1882 | 1887 | 10.1 | 11.3 | 14.6 | 14.1 | 5.3 | 5.6 |
| Fort Smith, Ark | 4.27 | 4.09 | 10.0 | 8.7 | 7.67 | 9.88 | 1888 | 1891 | 2.10 | 1.77 | 1882 | 1882 | 11.6 | 13.9 | 13.0 | 12.2 | 5.4 | 4.9 |
| New Orleans, La | 6.66 | 6.38 | 13.8 | 15.8 | 12.05 | 12.93 | 1883 | 1874 | 2.84 | 2.02 | 1881 | 1888 | 8.1 | 8.0 | 15.5 | 17.4 | 6.4 | 5.6 |
| Shreveport, La | 3.57 | 3.68 | 8.4 | 8.7 | 7.97 | 11.38 | 1889 | 1882 | 0.38 | 0.06 | 1881 | 1884 | 9.3 | 11.4 | 15.7 | 15.1 | 5.0 | 4.5 |
| Brownsville, Tex | 3.25 | 2.22 | 6.9 | 4.5 | 13.80 | 6.58 | 1887 | 1878 | 0.26 | 0.22 | 1891 | 1885 | 13.5 | 15.1 | 12.5 | 12.8 | 4.0 | 2.5 |
| El Paso, Tex | 0.53 | 2.17 | 4.0 | 8.4 | 2.63 | 8.18 | 1885 | 1881 | 0.02 | 0.06 | 1881-'83 | 1891 | 19.5 | 13.5 | 9.5 | 14.8 | 1.0 | 2.7 |
| Fort Davis, Tex | 2.09 | 3.31 | 8.2 | 10.0 | 3.64 | 10.11 | 1890 | 1880 | 0.07 | 0.35 | 1881 | 1884 | 15.7 | 15.4 | 12.5 | 11.6 | 1.8 | 4.0 |
| Fort Elliott, Tex | 3.18 | 2.32 | 6.9 | 5.3 | 9.82 | 5.65 | 1885 | 1882 | 0.10 | 0.49 | 1881 | 1881 | 13.2 | 14.5 | 12.8 | 13.1 | 3.7 | 3.4 |
| Galveston, Tex | 5.76 | 3.04 | 7.2 | 8.6 | 11.89 | 9.31 | 1871 | 1874 | 0.03 | 0.34 | 1881 | 1872 | 11.7 | 13.2 | 13.8 | 14.1 | 4.5 | 3.7 |
| Indianola, Tex | 2.64 | 2.29 | 5.3 | 6.6 | 7.56 | 5.76 | 1884 | 1874 | 0.21 | 0.32 | 1885 | 1883 | 12.2 | 14.7 | 16.8 | 15.0 | 1.0 | 1.3 |
| Palestine, Tex | 3.51 | 2.82 | 7.9 | 7.1 | 7.00 | 6.52 | 1889 | 1882 | 0.83 | 0.06 | 1882 | 1884 | 8.7 | 13.9 | 16.1 | 13.6 | 5.0 | 3.5 |
| Rio Grande City, Tex | 2.27 | 1.29 | 4.8 | 3.6 | 8.08 | 5.98 | 1887 | 1878 | 0.00 | 0.00 | 1885 | 1884 | 14.1 | 19.0 | 12.1 | 8.7 | 3.8 | 3.3 |
| San Antonio, Tex | 2.46 | 2.68 | 6.3 | 6.0 | 4.79 | 6.56 | 1889 | 1885 | 0.00 | 0.12 | 1881 | 1879 | 8.4 | 10.8 | 16.1 | 16.2 | 5.5 | 4.0 |
| Corsicana, Tex | 3.04 | 2.48 | 6.3 | 6.6 | 5.72 | 3.82 | 1889 | 1878 | 0.00 | 0.60 | 1881 | 1891 | 9.1 | 11.3 | 16.5 | 15.6 | 4.4 | 2.4 |

TABLE XVII.—*Temperature for months of June and July, exhibiting the uniform range.*

| Stations. | Monthly mean. | | Mean maximum. | | Mean minimum. | | Maximum. | | | | Minimum. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | June. | | July. | | June. | | July. | |
| | June. | July. | June. | July. | June. | July. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. |
| | ° | ° | ° | ° | ° | ° | | | | | | | | |
| Aberdeen, Miss | 76.6 | 78.7 | 86.8 | 89.2 | 66.4 | 68.1 | 98 | 1890, '91 | 98 | {1884, '85, '87 '88, '90} | 40 | 1889 | 55 | 1885 |
| Allendale, S. C | 77.6 | 80.1 | 88.8 | 90 | 66.4 | 70.2 | 102 | 1887 | 105 | 1883 | 43 | 1884 | 52 | 1884 |
| Atlanta, Ga | 75.7 | 78.3 | 84.3 | 86.7 | 67.2 | 70 | 98 | 1890 | 100 | 1887 | 39 | 1889 | 58 | 1882, '86, '91 |
| Auburn, Ala | 76.7 | 78.0 | 84.8 | 84.8 | 68.8 | 71.2 | 97 | 1881 | 100 | 1881 | 46 | 1889 | 59 | 1882 |
| Augusta, Ga | 79.2 | 82.2 | 89.1 | 91.8 | 69.3 | 72.6 | 103 | 1887 | 105 | 1878 | 46 | 1889 | 62 | 1876, '85 |
| Batesville, Miss | 78.3 | 81 | 88.4 | 91.6 | 68.2 | 70.4 | 104 | 1883 | 101 | 1883, '85 | 46 | 1889 | 58 | 1890, '91 |
| Branchville, S. C | 78.3 | 80.3 | 88.9 | 90.2 | 67.7 | 70.6 | 102 | 1890 | 103 | 1887 | 47 | 1889 | 56 | 1889, '90 |
| Brinkley, Ark | 76.4 | 80.4 | 88.9 | 92.4 | 63.9 | 68.4 | 100 | 1884 | 105 | 1885, '88 | 30 | 1884 | 42 | 1884 |
| Brookhaven, Miss | 78.9 | 81.1 | 90.4 | 92.5 | 67.4 | 69.7 | 100 | 1885, '91 | 104 | 1888 | 42 | 1889 | 57 | 1891 |
| Brownsville, Tex | 82.7 | 83.8 | 90.2 | 91.3 | 75.1 | 76.3 | 102 | 1878 | 98 | 1883 | 63 | 1877 | 65 | 1887 |
| Cedar Keys, Fla | 80.1 | 82 | 86.4 | 87.9 | 74.3 | 77.5 | 94 | 1880 | 96 | 1885 | 56 | 1889 | 68 | 1886 |
| Charleston, S. C | 79.4 | 82 | 86.4 | 88.9 | 72.4 | 75.1 | 100 | 1877, '80, '87 | 104 | 1879 | 51 | 1889 | 65 | 1886, '91 |
| Cheraw, S. C | 77.7 | 80.6 | 89.5 | 92.3 | 66 | 68.9 | 104 | 1887 | 108 | 1887 | 49 | 1884 | 52 | 1885 |
| Chester, S. C | 78.8 | 80.5 | 89.8 | 91.8 | 67.7 | 69.3 | 105 | 1887 | 110 | 1887 | 44 | 1889 | 57 | 1885 |
| Chattanooga, Tenn | 75.7 | 78.5 | 85.3 | 87.9 | 66.1 | 69.2 | 98 | 1889 | 101 | 1879 | 39 | 1889 | 56 | 1885 |
| Columbus, Miss | 80.7 | 82.6 | 93.4 | 95.2 | 68.1 | 70.1 | 105 | 1887, '91 | 107 | 1883 | 43 | 1889 | 58 | 1885, '86 |
| Corinth, Miss | 81.5 | 79.2 | 88.1 | 90.9 | 64.9 | 67.5 | 101 | 1887 | 100 | 1886, '87, '88 | 36 | 1889 | 52 | 1884, '88 |
| Corsicana, Tex | 80.4 | 84.3 | 92.1 | 95.7 | 70.4 | 73.7 | 104 | 1881 | 108 | 1881 | 50 | 1877 | 59 | 1877 |
| Coushatta, La | 80.7 | 82.4 | 91.8 | 94.1 | 69.7 | 70.8 | 103 | 1886 | 104 | 1883 | 45 | 1883 | 59 | 1891 |
| Charlotte, N. C | 75.9 | 78.6 | 85.4 | 87.9 | 66.3 | 69.3 | 102 | 1887 | 102 | 1887 | 45 | 1889 | 55 | 1891 |
| Devall Bluff, Ark | 76.8 | 79.4 | 88.2 | 91.1 | 65.5 | 67.7 | 99 | 1887 | 100 | 1885 | 48 | 1889 | 53 | 1887 |
| Edwards, Miss | 80.3 | 82.5 | 90.7 | 92.4 | 69.9 | 72.6 | 100 | 1891 | 101 | 1890 | 48 | 1889 | 63 | 1888, '91 |
| El Paso, Tex | 81.5 | 83.4 | 97.6 | 98 | 65.7 | 68.7 | 113 | 1883 | 111 | 1884, '86 | 50 | 1881 | 56 | 1880 |
| Fort Davis, Tex | 78.3 | 76.8 | 90.4 | 89.2 | 62.2 | 64.3 | 111 | 1881 | 110 | 1881 | 49 | 1881, '86 | 53 | 1881 |
| Florence, S. C | 78.3 | 80.6 | 90.3 | 91.7 | 66.3 | 69.6 | 103 | 1887 | 105 | 1887 | 49 | 1883 | 57 | 1890 |
| Fort Elliott, Tex | 73.7 | 78.1 | 85.6 | 90.6 | 61.8 | 65.7 | 100 | 1880, '81, '88 | 108 | 1889 | 44 | 1880, '82 | 49 | 1880 |
| Fort Smith, Ark | 77.2 | 81.5 | 87.6 | 92.6 | 66.8 | 70.3 | 101 | 1882 | 104.5 | 1884 | 50 | 1882 | 56 | 1891 |
| Galveston, Tex | 82.3 | 84.3 | 87.4 | 89.6 | 77.1 | 79 | 97 | 1875 | 97 | 1875 | 64 | 1877 | 67 | 1887 |
| Hardeeville, S. C | 79.1 | 81.5 | 89.9 | 91.9 | 68.3 | 71.2 | 103 | 1887 | 103 | 1883, '87 | 46 | 1889 | 53 | 1883 |
| Hatteras, N. C | 74 | 77.6 | 79.2 | 82.6 | 68.9 | 72.6 | 91 | 1882 | 92 | 1881 | 57 | 1876, '84 | 61 | 1885 |
| Hernando, Miss | 78.1 | 80.4 | 89.2 | 92.3 | 67.1 | 68.4 | 105 | 1883 | 108 | 1883 | 49 | 1883 | 49 | 1883 |
| Jackson, Miss | 74.9 | 81.9 | 81.5 | 92.5 | 68.4 | 71.3 | 102 | 1885, '91 | 103 | 1884 | 44 | 1889 | 60 | 1885 |
| Jacksonboro, S. C | 77.5 | 79.4 | 89.8 | 89.9 | 65.2 | 68.9 | 105 | 1887 | 104 | 1887 | 44 | 1889 | 53 | 1885, '88 |
| Jacksonville, Fla | 80.7 | 82.9 | 89 | 91.1 | 72.5 | 74.6 | 101 | 1880 | 104 | 1879 | 54 | 1889 | 66 | 1890, '91 |
| Kingstree, S. C | 77.9 | 79 | 90.1 | 90.1 | 65.8 | 67.9 | 103 | 1887 | 103 | 1887, '88 | 44 | 1887 | 51 | 1885 |
| Kittyhawk, N. C | 74.2 | 78.3 | 80.8 | 84.5 | 67.6 | 72 | 99 | 1880 | 107 | 1887 | 52 | 1884 | 59 | 1888 |
| Knoxville, Tenn | 74.2 | 77.4 | 84.1 | 87.1 | 64.3 | 67.4 | 96 | 1874, '80, '87 | 100 | 1879, '87 | 44 | 1889 | 52 | 1885 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake, Miss | 76.4 | 80.4 | 90.1 | 91.7 | 62.7 | 69.2 | 100 | 1891 | 102 | 1887 | 40 | 1889 | 47 | 1885 |
| Little Rock, Ark | 77.8 | 81.1 | 86.7 | 90.1 | 68.8 | 72.1 | 98 | 1882 | 101.3 | 1884 | 51 | 1889 | 60 | 1891 |
| Macon, Miss | 80 | 81.9 | 92.8 | 94.3 | 67.3 | 69.6 | 102 | 1887, '91 | 103 | 1883 | 42 | 1889 | 50 | 1890 |
| Malvern, Ark | 76.1 | 81.6 | 89.6 | 93.9 | 65.6 | 69.4 | | | | | | | | |
| Memphis, Tenn | 78 | 81.4 | 87 | 90.1 | 69 | 72.7 | 100 | 1881 | 99 | 1875, '79, '81, '87 | 50 | 1889 | 58 | 1891 |
| Mobile, Ala | 80.4 | 82.6 | 88.8 | 90.8 | 72.1 | 74.4 | 100 | 1877, '82 | 101 | 1881, '83 | 50 | 1889 | 64 | 1882 |
| Monroe, La | 79.7 | 82.2 | 90 | 92.3 | 69.5 | 72.1 | 99 | 1887, '91 | 99 | 1884, '87, '88 | 46 | 1889 | 55 | 1887 |
| Montgomery, Ala | 80.4 | 82.6 | 89.8 | 91.9 | 71.1 | 73.3 | 105.5 | 1881 | 107 | 1881 | 48 | 1889 | 61 | 1882 |
| Nashville, Tenn | 75.9 | 79.6 | 85.3 | 89.1 | 66.5 | 70.1 | 99 | 1874 | 101 | 1874, '79, '81 | 46 | 1889 | 56 | 1882, '91 |
| Natchitoches, La | 79.3 | 81.7 | 88.3 | 90.8 | 70.3 | 72.5 | 99 | 1891 | 98 | 1887, '89, '90 | 52 | 1889 | 63 | 1888 |
| New Orleans, La | 80.6 | 82.7 | 87.2 | 89.1 | 74.1 | 76.2 | 97 | 1881 | 96 | 1877, '87, '88, '90 | 58 | 1889 | 68 | 1890, '91 |
| Okolona, Miss | 80.0 | 82.8 | 92.4 | 95.1 | 67.6 | 70.5 | 105 | 1885, '87 | 106 | 1883, '85 | 44 | 1889 | 58 | 1891 |
| Palestine, Tex | 79.0 | 82.3 | 88.4 | 92.0 | 69.7 | 72.6 | 97 | 1886 | 102 | 1887 | 55 | 1882, '89 | 63 | 1882 |
| Pensacola, Fla | 79.8 | 81.4 | 86.1 | 87.9 | 73.6 | 74.8 | 97 | 1881 | 99 | 1887 | 55 | 1889 | 64 | 1882 |
| Prescott, Ark | 77.9 | 81.1 | 88.6 | 92.7 | 67.2 | 69.6 | 102 | 1883 | 103 | 1884 | 53 | 1885 | 51 | 1884 |
| Rio Grande City, Tex | 85.5 | 87.4 | 96.7 | 99.2 | 74.3 | 75.6 | 109 | 1883 | 110 | 1884 | 62 | 1877, '83, '90 | 62 | 1877, '83 |
| Savannah, Ga | 79.6 | 82.4 | 87.5 | 90.1 | 71.7 | 74.6 | 100 | 1880, '87 | 105 | 1879 | 59 | 1877, '84 | 64 | 1891 |
| San Antonio, Tex | 81.2 | 83.5 | 91.2 | 94.1 | 71.2 | 72.9 | 103 | 1883 | 104 | 1882, '91 | 53 | 1877 | 58 | 1878 |
| Shreveport, La | 81.0 | 83.8 | 91.0 | 93.7 | 71.0 | 73.9 | 104 | 1875 | 107 | 1875 | 55 | 1877, '89 | 64 | 1877, '80, '82, '91 |
| Spartanburg, S. C | 75.6 | 78.4 | 87.6 | 90.6 | 63.6 | 66.1 | 102 | 1888 | 104 | 1887, '88, '89 | 42 | 1887, '89 | 46 | 1891 |
| Saint Matthews, S. C | 78.2 | 80.7 | 88.7 | 90.7 | 67.7 | 70.8 | 105 | 1887 | 106 | 1887 | 46 | 1889 | 55 | 1885 |
| Saint Georges, S. C | 78.8 | 80.4 | 90.4 | 91.7 | 66.4 | 69.1 | 104 | 1887 | 105 | 1887 | 48 | 1884, '89 | 55 | 1885 |
| Texarkana, Ark | 77.0 | 81.3 | 89.1 | 93.2 | 64.9 | 69.3 | 100 | 1886 | 102 | 1884 | 37 | 1884 | 54 | 1886 |
| Vicksburg, Miss | 79.5 | 82.4 | 89.0 | 91.7 | 70.5 | 73.0 | 101 | 1881 | 100 | 1878, '81 | 52 | 1889 | 62 | 1881, '91 |
| Waynesboro, Miss | 79.2 | 81.8 | 91.1 | 93.4 | 67.4 | 70.2 | 104 | 1883, '91 | 106 | 1883 | 41 | 1889 | 55 | 1883 |
| Wilmington, N. C | 76.2 | 79.5 | 84.4 | 86.7 | 67.9 | 72.2 | 100 | 1880, '90 | 103 | 1879 | 51 | 1884 | 58 | 1890 |

A remarkable fact concerning these two months consists in the very uniform range of not only the normal temperature but also in the annual means of the months. In June there are only 10° between the greatest normal and the least; while in July there are only 8° difference. When one year is compared with another the following results become apparent: For the sake of contrast one station from each of the sections of the belt (north, middle, and southern) has been selected—

*Memphis.*—The mean temperature for June, during a period of twenty years, ranged from 70° to 80°, and for eighteen years was above 75°. For July the range was from 77° to 84°. Fifteen of the twenty years furnished mean temperatures above 80°.

*Montgomery.*—This station has a record of nineteen years. The range of the mean temperature was in June from 77° to 83°; in July it was from 79° to 86°. In June, for thirteen years, the mean temperature was above 80°, while in July, for sixteen years, it was above 80°.

*Savannah.*—For eighteen years the mean temperature in June ranged between 71° and 83°. For nine years it was above 80°, and for sixteen years it was above 78°. During July the temperature ranged between 79° and 85°. Eight of the twenty years covering the records gave a temperature above 84°.

These records show a very uniform condition of the temperature that is so suitable for the successful cultivation of the cotton during its flowering period. The air is well warmed by the sun's rays and the thermometer often reaches 90°. What has already been shown in regard to the mean temperature is true in relation to the mean maxima and mean minima. At New Orleans for a period of twenty years the mean maximum temperature in June ranged between 84.6° and 91.3°. For ten years there was less than 1° difference between the mean maxima temperatures. In July out of eighteen years thirteen of them gave less than 3° range between the mean maxima, and the mean minima temperatures for the same period of time ranged between 70.3° and 78° for June and 74.5° and 77.8° in July; thus showing, what has already been said, that practically the same mean temperature, so far as the influence on plants is concerned, may occur from year to year. This fact may be more strikingly exhibited by means of the following comparison between the mean maxima and the maxima temperatures at some of the stations in the cotton belt:

TABLE XVIII.—*Maximum and mean maximum temperatures at certain stations in the cotton belt for the month of July.*

| Stations. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | 1886. | 1887. | 1888. | 1889. | 1890. | 1891. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Atlanta | 97 | 94 | 98 | 90 | 95 | 90 | 91 | 92 | 100 | 94 | 95 | 96 | 90 |
| | 87.0 | 87.7 | 89.8 | 83.6 | 89.4 | 85.1 | 86.5 | 85.6 | 85.6 | 88.4 | 87.0 | 87.3 | 84.0 |
| Fort Smith | ..... | ..... | ..... | 100 | 100 | 104 | 99 | 103 | 104 | 100 | 98 | 101 | 97 |
| | ..... | ..... | ..... | 91.9 | 96.4 | 96.7 | 91.6 | 91.5 | 95.8 | 92.6 | 91.2 | 94.7 | 87.1 |
| Knoxville | 100 | 94 | 99 | 89 | 96 | 91 | 94 | 94 | 100 | 93 | 92 | 95 | 90 |
| | 90.2 | 85.6 | 90.3 | 82.4 | 87.0 | 85.1 | 87.3 | 84.6 | 89.0 | 87.4 | 86.1 | 87.4 | 82.3 |
| Memphis | 99 | 95 | 99 | 93 | 97 | 97 | 96 | 96 | 99 | 97 | 94 | 98 | 94 |
| | 93.0 | 88.1 | 92.7 | 83.9 | 89.8 | 90.7 | 90.8 | 89.5 | 91.1 | 91.8 | 88.9 | 90.3 | 88.7 |
| Kittyhawk | ..... | 96 | 99 | 96 | 100 | 97 | 98 | 91 | 107 | 100 | 100 | 96 | 89 |
| | ..... | 83.2 | 83.4 | 79.7 | 86.6 | 84 | 89.7 | 81.5 | 91.4 | 83.5 | 86.8 | 83.8 | 80.6 |
| Charleston | 104 | 97 | 103 | 94 | 101 | 95 | 94 | 92 | 98 | 100 | 97 | 92 | 95 |
| | 89.5 | 90.9 | 90.5 | 89.2 | 92.1 | 88.9 | 89.1 | 86.8 | 88.7 | 87.1 | 87.4 | 86.3 | 86.5 |
| Montgomery | 101 | 100 | 107 | 95 | 99 | 95 | 98 | 95 | 100 | 98 | 99 | 97 | 94 |
| | 92.8 | 93.1 | 95.9 | 87.8 | 94.2 | 90.9 | 91.0 | 90.9 | 90.7 | 92.5 | 91.0 | 90.7 | 88.7 |
| Palestine | ..... | ..... | ..... | 98 | 97 | 98 | 95 | 97 | 102 | 94 | 99 | 97 | 96 |
| | ..... | ..... | ..... | 90.0 | 92.9 | 94.0 | 91.2 | 91.8 | 94.6 | 89.8 | 92.1 | 92.6 | 90.5 |
| Vicksburg | 98 | 97 | 100 | 96 | 96 | 99 | 99 | 96 | 95 | 97 | 94 | 99 | 93 |
| | 93.2 | 91.3 | 97.4 | 88.9 | 92.8 | 93.8 | 92.4 | 89.8 | 89.6 | 92.4 | 89.5 | 91.6 | 87.7 |
| Brownsville | 95 | 95 | 96 | 94 | 98 | 95 | 94 | 93 | 92 | 94 | 94 | 94 | 95 |
| | 92.1 | 89.8 | 92.7 | 91.1 | 93.9 | 92.2 | 91.9 | 89.1 | 89.3 | 90.8 | 91.0 | 91.7 | 91.3 |
| Jacksonville | 104 | 97 | 99 | 91 | 98 | 96 | 95 | 94 | 100 | 90 | 97 | 96 | 95 |
| | 92.8 | 92.4 | 91.9 | 89.0 | 92.2 | 90.6 | 91.3 | 89.3 | 91.3 | 90.4 | 89.7 | 89.5 | 89.4 |
| Mobile | 100 | 98 | 101 | 97 | 101 | 96 | 94 | 93 | 98 | 97 | 95 | 96 | 93 |
| | 91.0 | 92.0 | 94.0 | 89.1 | 95.7 | 89.7 | 89.5 | 87.2 | 90.1 | 90.7 | 88.7 | 88.0 | 87.4 |
| New Orleans | 91 | 92 | 95 | 92 | 94 | 95 | 92 | 93 | 96 | 96 | 95 | 96 | 92 |
| | 87.9 | 88.3 | 90.1 | 86.6 | 90.3 | 90.7 | 90.1 | 88.1 | 90.2 | 90.7 | 90.1 | 88.6 | 87.7 |

TABLE XIX.—*Percentage of mean cloudy days and probability of rainy days in the cotton region, compiled from the records covering the period from* 1871 *to* 1888.

PERCENTAGE OF CLOUDY DAYS.

| Stations. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Northern section.* | % | % | % | % | % | % | % | % | % | % | % | % |
| Atlanta, Ga | 58 | 53 | 46 | 45 | 46 | 52 | 46 | 50 | 43 | 42 | 46 | 51 |
| Charlotte, N. C | 60 | 52 | 50 | 49 | 52 | 53 | 53 | 53 | 49 | 43 | 45 | 51 |
| Chattanooga, Tenn | 61 | 58 | 52 | 46 | 46 | 47 | 44 | 48 | 44 | 43 | 47 | 57 |
| El Paso, Tex | 29 | 30 | 27 | 23 | 24 | 28 | 37 | 35 | 29 | 25 | 31 | 28 |
| Fort Davis Tex | 31 | 31 | 31 | 26 | 28 | 30 | 35 | 36 | 36 | 31 | 32 | 29 |
| Fort Elliott, Tex | 31 | 33 | 34 | 37 | 41 | 37 | 34 | 33 | 30 | 32 | 31 | 32 |
| Fort Smith, Ark | 50 | 56 | 50 | 49 | 41 | 44 | 38 | 41 | 38 | 40 | 45 | 51 |
| Knoxville, Tenn | 62 | 57 | 53 | 48 | 45 | 49 | 46 | 45 | 41 | 39 | 52 | 54 |
| Little Rock, Ark | 54 | 56 | 51 | 44 | 46 | 42 | 39 | 37 | 37 | 37 | 44 | 52 |
| Memphis, Tenn | 58 | 57 | 51 | 47 | 46 | 45 | 42 | 40 | 40 | 38 | 51 | 56 |
| Nashville, Tenn | 64 | 61 | 56 | 53 | 50 | 52 | 48 | 44 | 44 | 42 | 53 | 62 |
| *Middle section.* | | | | | | | | | | | | |
| Auburn, Ala | 59 | 55 | 47 | 46 | 45 | 51 | 48 | 49 | 44 | 41 | 46 | 50 |
| Augusta, Ga | 51 | 49 | 45 | 44 | 42 | 48 | 47 | 50 | 46 | 37 | 45 | 48 |
| Charleston, S. C | 50 | 47 | 43 | 41 | 42 | 49 | 48 | 50 | 47 | 37 | 42 | 47 |
| Green Springs, Ala | 48 | 35 | 29 | 30 | 18 | 21 | 19 | 20 | 16 | 19 | 30 | 37 |
| Hatteras, N. C | 56 | 48 | 46 | 43 | 43 | 46 | 42 | 46 | 41 | 42 | 47 | 49 |
| Kittyhawk, N. C | 54 | 47 | 48 | 49 | 43 | 44 | 44 | 52 | 45 | 44 | 48 | 51 |
| Montgomery, Ala | 60 | 55 | 47 | 46 | 44 | 51 | 49 | 49 | 45 | 41 | 47 | 50 |
| Palestine, Tex | 53 | 55 | 50 | 52 | 47 | 43 | 37 | 38 | 39 | 39 | 47 | 52 |
| Shreveport, La | 58 | 55 | 51 | 49 | 46 | 45 | 40 | 36 | 37 | 37 | 46 | 53 |
| Vicksburg, Miss | 58 | 55 | 49 | 44 | 43 | 42 | 42 | 41 | 45 | 38 | 48 | 54 |
| Wilmington, N. C | 54 | 51 | 47 | 44 | 46 | 49 | 50 | 52 | 49 | 41 | 46 | 49 |
| *Southern section.* | | | | | | | | | | | | |
| Brownsvilie, Tex | ..... | 56 | 56 | 55 | 46 | 39 | 34 | 41 | 47 | 41 | 52 | 53 |
| Cedar Keys, Fla | 45 | 38 | 41 | 36 | 40 | 50 | 52 | 49 | 41 | 35 | 37 | 43 |
| Galveston Tex | 54 | 53 | 51 | 48 | 47 | 41 | 38 | 41 | 42 | 37 | 45 | 51 |
| Indianola, Tex | 53 | 54 | 56 | 50 | 49 | 39 | 37 | 37 | 39 | 37 | 46 | 54 |
| Jacksonville, Fla | 49 | 45 | 40 | 40 | 40 | 47 | 43 | 44 | 48 | 43 | 45 | 47 |
| Mobile, Ala | 54 | 50 | 48 | 47 | 43 | 49 | 49 | 49 | 44 | 40 | 45 | 51 |
| New Orleans, La | 53 | 50 | 46 | 48 | 45 | 46 | 48 | 46 | 45 | 39 | 47 | 53 |
| Pensacola, Fla | 56 | 49 | 44 | 44 | 42 | 45 | 47 | 49 | 42 | 40 | 46 | 51 |
| Rio Grande City, Tex | ..... | 47 | 49 | 45 | 40 | 36 | 26 | 38 | 47 | 39 | 46 | 43 |
| San Antonio, Tex | 51 | 54 | 53 | 52 | 53 | 45 | 45 | 44 | 44 | 43 | 50 | 49 |
| Savannah, Ga | 50 | 48 | 43 | 42 | 42 | 49 | 48 | 50 | 48 | 40 | 45 | 46 |

TABLE XIX.—*Percentage of mean cloudy days, &c.*—Continued.

PROBABILITY OF RAINY DAYS.

| Stations. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Northern section.* | | | | | | | | | | | | |
| Atlanta, Ga | 47 | 39 | 38 | 35 | 33 | 38 | 33 | 41 | 28 | 26 | 34 | 39 |
| Charlotte, N. C | 46 | 38 | 38 | 34 | 39 | 41 | 39 | 36 | 25 | 27 | 31 | 38 |
| Chattanooga, Tenn | 49 | 47 | 41 | 35 | 36 | 43 | 41 | 39 | 32 | 27 | 31 | 40 |
| El Paso, Tex | 11 | 14 | 9 | 4 | 8 | 12 | 29 | 28 | 21 | 15 | 12 | 11 |
| Fort Davis, Tex | 11 | 9 | 10 | 12 | 17 | 29 | 32 | 33 | 29 | 16 | 14 | 8 |
| Fort Elliott, Tex | 9 | 11 | 15 | 18 | 29 | 25 | 23 | 26 | 18 | 19 | 9 | 11 |
| Fort Smith, Ark | 24 | 29 | 28 | 38 | 29 | 32 | 29 | 26 | 20 | 23 | 26 | 25 |
| Knoxville, Tenn | 47 | 42 | 41 | 39 | 39 | 43 | 41 | 37 | 26 | 28 | 32 | 39 |
| Little Rock, Ark | 35 | 37 | 38 | 33 | 37 | 37 | 31 | 31 | 22 | 24 | 32 | 32 |
| Memphis, Tenn | 41 | 39 | 41 | 37 | 34 | 36 | 29 | 27 | 25 | 24 | 36 | 37 |
| Nashville, Tenn | 42 | 40 | 40 | 37 | 34 | 40 | 35 | 29 | 27 | 24 | 35 | 39 |
| *Middle section.* | | | | | | | | | | | | |
| Auburn, Ala | 40 | 38 | 35 | 30 | 31 | 38 | 33 | 40 | 26 | 23 | 30 | 38 |
| Augusta, Ga | 38 | 37 | 35 | 29 | 30 | 37 | 45 | 39 | 26 | 24 | 31 | 33 |
| Charleston, S. C | 38 | 35 | 32 | 27 | 28 | 36 | 36 | 42 | 36 | 26 | 27 | 32 |
| Green Springs, Ala | 28 | 31 | 30 | 27 | 19 | 27 | 22 | 26 | 16 | 18 | 22 | 30 |
| Hatteras, N. C | 52 | 36 | 39 | 34 | 31 | 37 | 33 | 44 | 25 | 22 | 32 | 41 |
| Kittyhawk, N. C | 50 | 38 | 43 | 39 | 33 | 33 | 36 | 43 | 26 | 30 | 37 | 36 |
| Montgomery, Ala | 40 | 38 | 35 | 31 | 31 | 40 | 34 | 36 | 24 | 21 | 29 | 38 |
| Palestine, Tex | 36 | 36 | 31 | 32 | 32 | 26 | 24 | 23 | 25 | 23 | 31 | 33 |
| Shreveport, La | 38 | 39 | 34 | 33 | 27 | 33 | 33 | 22 | 25 | 22 | 31 | 34 |
| Vicksburg, Miss | 41 | 39 | 34 | 32 | 26 | 34 | 31 | 29 | 25 | 22 | 33 | 36 |
| Wilmington, N. C | 42 | 39 | 36 | 31 | 32 | 38 | 41 | 47 | 33 | 26 | 28 | 36 |
| *Southern section.* | | | | | | | | | | | | |
| Brownsville, Tex | 31 | 28 | 31 | 12 | 21 | 22 | 18 | 24 | 36 | 25 | 25 | 23 |
| Cedar Keys, Fla | 31 | 23 | 25 | 19 | 23 | 38 | 46 | 41 | 29 | 23 | 22 | 28 |
| Galveston, Tex | 38 | 36 | 31 | 23 | 23 | 27 | 33 | 33 | 34 | 25 | 31 | 38 |
| Indianola, Tex | 32 | 28 | 33 | 19 | 18 | 22 | 22 | 28 | 35 | 24 | 29 | 32 |
| Jacksonville, Fla | 31 | 33 | 25 | 24 | 32 | 45 | 46 | 46 | 47 | 32 | 28 | 25 |
| Mobile, Ala | 37 | 31 | 34 | 26 | 27 | 44 | 41 | 41 | 31 | 22 | 25 | 33 |
| New Orleans, La | 36 | 33 | 32 | 27 | 32 | 46 | 51 | 47 | 36 | 24 | 32 | 39 |
| Pensacola, Fla | 42 | 25 | 31 | 26 | 24 | 42 | 48 | 45 | 31 | 22 | 29 | 35 |
| Rio Grande City, Tex | 19 | 12 | 15 | 11 | 21 | 15 | 11 | 21 | 24 | 18 | 16 | 18 |
| San Antonio, Tex | 31 | 29 | 24 | 26 | 26 | 21 | 19 | 22 | 28 | 23 | 25 | 24 |
| Savannah, Ga | 34 | 34 | 29 | 30 | 29 | 43 | 38 | 43 | 38 | 25 | 25 | 31 |

## VI.—CHARACTER OF WEATHER BEST SUITED FOR THE PRODUCTION OF FIBER DURING ITS PROCESS OF FORMATION.

The first boll generally opens early in August, the interval from the first bloom to the first boll being about 40 to 50 days, the shorter interval being required later in the season. The plant continues to bloom during the month of August and until the latter part of September, but its powers in this regard are steadily reduced as the vitality goes more and more into growing the already formed bolls and bringing them to maturity. In the Southern States the cotton plant is decidedly an annual, whatever may have been its condition in its original form, and the work of perfecting its seed completes its life. It is a question of considerable interest, that if the frosts of autumn could be delayed from year to year until late in the winter, how long would the cotton plant continue to bloom and mature bolls of well-developed fiber?

During this period in the history of the cotton plant there must be an abundance of sunshine and a small amount of moisture. At this time the plant has reached its full height and the largest share of its vitality must go towards making seed and developing fiber. If much rain occurs at this stage in its life three deleterious results will take place: First, the "weed" or stem, leaves, and branches will begin rapidly to multiply to the detriment of the fruit. The plant will

stop blooming and the squares already formed will shed because of the too rapid growth of the parts of the branches to which they are attached. Second, the bolls already formed will begin to decay, caused by the surplus water absorbed by them, and thus rendered unable to open, since it takes a large per cent. of warmth and sunlight to cause the bolls to open, they will be destroyed. Third, the fiber in the bolls already opened, when the rain season begins will be beaten out on the ground and lost or badly stained. It is therefore best for the condition of the cotton plant that much dry weather must prevail during the months of August and September. There is not much necessity for rains and only enough moisture is required to satisfy the demands of the plant as it supplies new material to the growing bolls and opening flowers. Much of this moisture, however, can be secured through the roots, if they have been forced deep into the soil by seasonable weather during the early period of the plant, as already mentioned in the first portions of this monograph. An occasional light shower, to prevent the soil from becoming too dry, will suit all requirements.

Although droughts occur frequently during the months of July and August, still the normal results indicate for the entire cotton belt 43.5 per cent. of cloudy days while the probability of rainy days is 34.5 per cent. The sun is likely, under these conditions, to shine unclouded 56.5 days in the 100. This character of the season is most propitious for the plant in its flowering and boll-forming period.

The above table of cloudy days and probability of rainy days, simply shows, in the case of rain, how many days in 100 may produce 0.01 of an inch or more of rain. In September the probability of rain in the northern section of the cotton belt is as 1 : 4, or one day in four may produce rain. The normal rainfall for this month in the same region of the cotton belt is 3.03 inches. So that the eight days of precipitation may produce on an average 0.38 of an inch each day. This indicates a dry month in its normal condition, and therefore very favorable for gathering the staple. The large per cent. of sunshine, 61 per cent., causes the bolls to open rapidly and preserves the fiber in its purest whiteness. The tables of rainfall and days of rain and cloudiness show that this character of weather continues through October; thus furnishing two months of fine season for gathering the crops. In the central portion of the belt we find a similar condition of the cast of the sky. The probability of rain in September is 27 per cent. out of 100; and the per cent. of cloudy days is 44, or 66 per cent. of sunshiny weather. The normal rainfall for this section for September is 4.74 inches, or 0.59 of an inch for each of the eight days of rain. There is more rain throughout the southern belt than in either of the other two. The normal is 5.72 inches, the probability of rain is 1 : 3, or 33 days in 100 may produce rain.

The per cent. of cloudy days is 44.8. So that during September there is a probability of 55 days of sunshiny weather in 100.

An interesting fact is brought out in the study of this table of percentages. By a glance at Chart VII, locating the limits of the cotton belt, it will be noticed that a large portion of the western and southwestern parts of Texas produce no cotton, although attempts have been made to extend the belt much beyond its present terminus. An explanation of this failure will be readily understood when it will be seen that the probability of rainy days throughout the year is so small at all stations that this scarcity of rain, coupled with the low range of temperature given for these stations, will discourage all efforts to grow cotton in that section of the country.

TABLE XX.—*Normal condition of the atmosphere during August and September, as regards the amount of sunshine and rainfall.*

| Stations. | Number of cloudless days. | | Number of partly cloudy days. | | Number of cloudy days. | | Rainfall (in inches). | | Number of days of rainfall. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aug. | Sept. | Aug. | Sept. | Aug. | Sept. | Aug. | Sept. | Aug. | Sept. |
| Charlotte, N. C | 9.1 | 10.5 | 12.3 | 10.8 | 9.6 | 8.7 | 5.46 | 3.24 | 10.6 | 8.9 |
| Hatteras, N. C | 11.2 | 13.6 | 11.8 | 11.2 | 8.0 | 6.2 | 6.52 | 6.61 | 13.8 | 7.8 |
| Kittyhawk, N.C | 8.4 | 11.5 | 14.9 | 11.3 | 7.7 | 7.2 | 7.48 | 5.18 | 12.9 | 5.4 |
| Wilmington, N.C | 8.5 | 10.4 | 13.5 | 10.9 | 9.0 | 8.7 | 7.80 | 6.70 | 13.7 | 9.8 |
| Charleston, S. C | 9.2 | 10.6 | 13.5 | 10.8 | 8.3 | 8.6 | 6.43 | 6.06 | 12.5 | 9.8 |
| Atlanta, Ga | 8.0 | 12.6 | 15.0 | 11.7 | 8.0 | 5.7 | 4.39 | 4.21 | 13.1 | 9.7 |
| Augusta, Ga | 8.2 | 10.2 | 15.0 | 12.1 | 7.8 | 7.7 | 4.83 | 3.74 | 10.8 | 8.0 |
| Savannah, Ga | 7.7 | 8.7 | 15.3 | 11.7 | 8.0 | 9.6 | 7.65 | 5.89 | 13.5 | 11.5 |
| Cedar Keys, Fla | 8.7 | 11.9 | 13.9 | 12.9 | 8.4 | 5.2 | 7.72 | 5.37 | 13.1 | 10.1 |
| Jacksonville, Fla | 8.7 | 9.1 | 16.4 | 12.2 | 5.9 | 8.7 | 6.80 | 8.06 | 15.5 | 14.1 |
| Pensacola, Fla | 10.5 | 12.4 | 14.0 | 12.3 | 6.5 | 5.3 | 8.13 | 5.25 | 13.6 | 10.0 |
| Chattanooga, Tenn | 8.6 | 11.3 | 15.4 | 12.1 | 7.0 | 6.6 | 4.16 | 4.24 | 13.2 | 10.9 |
| Knoxville, Tenn | 10.3 | 13.5 | 14.0 | 9.5 | 6.7 | 7.0 | 4.28 | 3.06 | 12.6 | 9.6 |
| Nashville, Tenn | 11.2 | 11.4 | 14.2 | 11.6 | 5.6 | 7.0 | 3.62 | 3.83 | 9.4 | 9.3 |
| Memphis, Tenn | 13.7 | 13.0 | 11.7 | 10.0 | 5.6 | 7.0 | 3.82 | 3.23 | 9.9 | 8.6 |
| Auburn, Ala | 9.4 | 8.9 | 15.0 | 13.3 | 6.6 | 7.8 | 4.20 | 3.29 | 12.4 | 7.5 |
| Mobile, Ala | 8.1 | 11.2 | 15.9 | 12.0 | 7.0 | 6.8 | 6.41 | 5.06 | 12.8 | 9.5 |
| Montgomery, Ala | 8.3 | 11.7 | 16.3 | 10.7 | 6.4 | 7.6 | 3.80 | 3.11 | 12.0 | 8.6 |
| Vicksburg, Miss | 11.2 | 12.0 | 15.1 | 10.0 | 4.7 | 8.0 | 3.50 | 3.85 | 8.7 | 9.1 |
| Little Rock, Ark | 14.5 | 13.4 | 12.4 | 11.6 | 4.1 | 5.0 | 3.92 | 3.23 | 8.9 | 8.4 |
| Fort Smith, Ark | 15.3 | 14.9 | 9.6 | 8.6 | 6.1 | 6.5 | 3.65 | 3.61 | 8.4 | 8.1 |
| New Orleans, La | 8.1 | 10.9 | 17.9 | 13.1 | 5.0 | 6.0 | 6.02 | 4.82 | 14.5 | 10.6 |
| Shreveport, La | 13.6 | 13.9 | 13.9 | 9.7 | 3.5 | 6.4 | 2.05 | 4.25 | 5.7 | 8.3 |
| Brownsville, Tex | 12.4 | 11.1 | 15.1 | 12.8 | 3.5 | 6.1 | 3.90 | 7.73 | 7.3 | 11.5 |
| El Paso, Tex | 15.0 | 16.7 | 11.7 | 8.9 | 4.3 | 4.4 | 1.87 | 1.22 | 9.4 | 5.3 |
| Fort Davis, Tex | 14.0 | 13.7 | 12.6 | 10.5 | 4.4 | 5.8 | 4.17 | 2.90 | 10.8 | 7.4 |
| Fort Elliott, Tex | 16.1 | 17.1 | 9.9 | 9.2 | 5.0 | 3.7 | 3.27 | 1.77 | 8.3 | 5.3 |
| Galveston, Tex | 13.3 | 12.6 | 12 9 | 10.7 | 4.8 | 6.7 | 2.94 | 7.07 | 10.3 | 11.0 |
| Indianola, Tex | 13.4 | 11.8 | 16.6 | 14.8 | 1.0 | 3.4 | 3.88 | 7.01 | 8.5 | 12.8 |
| Palestine, Tex | 13.0 | 12.9 | 14.8 | 10.5 | 3.2 | 6.6 | 2.51 | 3.21 | 6.7 | 8.2 |
| Rio Grande City, Tex | 14.6 | 11.5 | 10.7 | 12.1 | 5.7 | 6.4 | 2.94 | 3.78 | 4.9 | 9.4 |
| San Antonio, Tex | 8.7 | 10.2 | 18.3 | 11.8 | 4.0 | 8.0 | 3.45 | 4.16 | 6.7 | 9.7 |
| Corsicana, Tex | 14.1 | 12.3 | 14.5 | 10.9 | 2.4 | 6.8 | 1.60 | 3.09 | 4.7 | 5.6 |

## VII.—THE PICKING SEASON AND ITS WEATHER.

The months of autumn are spent in gathering the staple, and by the end of November, if the season is favorable, almost the entire crop will be picked. All that the cotton planters desire during this period of the year is that frost will be delayed as late as the last week in November, and that after the middle of September heavy rainstorms will not occur, but that showers, if they come at all, shall be light and not frequent. This condition of the atmosphere will

enable the pickers to gather the cotton as fast as it opens, in all its beautiful whiteness, unsullied by dampness, mold, or dirt. It is not often in the South that heavy rains occur in autumn, and monthly averages seldom go above 3.50 inches, but more frequently fall below 2.00 inches. The winds are also generally light so that the cotton is not greatly damaged by being driven out on to the ground and stained.

It is a trite saying among the farmers that all flowers that open after the 25th of September will fail to produce mature bolls, unless the season is unusually prolonged into the winter months. This is based on the idea that frosts usually come early in November, and together with cool nights, preceding the killing frosts, cause the plant to lose a large part of its growing vitality and the young bolls will stop developing before the seed and fiber are matured.

Table XXI has been prepared to show the time of occurrence of frosts in the cotton belt. The results are averaged for the entire region. In the extreme southern portions of the belt the frost will come later than in the more northern parts of the section under consideration. For instance, frosts may be expected along the coasts of Georgia and Alabama any time after November 15, while at Atlanta, Starkville, Vicksburg, and Palestine killing frost will come generally as soon as November 1. At Charlotte, Chattanooga, and Nashville it is as early as October 15.

TABLE XXI.—*Dates of killing frosts in the cotton belt.*

| Years. | October. | November. | December. | Years. | October. | November. | December. |
|---|---|---|---|---|---|---|---|
| 1832 | 20 | ..... | ..... | 1862 | ..... | ..... | ..... |
| 1833 | 21 | ..... | ..... | 1863 | 24 | ..... | ..... |
| 1834 | 20 | ..... | ..... | 1864 | ..... | ..... | ..... |
| 1835 | ..... | 12 | ..... | 1865 | 20 | ..... | ..... |
| 1836 | ..... | ..... | ..... | 1866 | ..... | ..... | ..... |
| 1837 | 26 | ..... | ..... | 1867 | ..... | 26 | ..... |
| 1838 | ..... | ..... | ..... | 1868 | ..... | 24 | ..... |
| 1839 | ..... | ..... | ..... | 1869 | ..... | 21 | ..... |
| 1840 | ..... | 14 | ..... | 1870 | ..... | 18 | ..... |
| 1841 | 25 | ..... | ..... | 1871 | ..... | 29 | ..... |
| 1842 | 25 | ..... | ..... | 1872 | ..... | 15 | ..... |
| 1843 | ..... | ..... | ..... | 1873 | ..... | 7 | ..... |
| 1844 | ..... | 14 | ..... | 1874 | ..... | ..... | 7 |
| 1845 | 12 | ..... | ..... | 1875 | ..... | ..... | 1 |
| 1846 | 19 | ..... | ..... | 1876 | ..... | 26 | ..... |
| 1847 | ..... | 30 | ..... | 1877 | ..... | 19 | ..... |
| 1848 | ..... | 1 | ..... | 1878 | ..... | 20 | ..... |
| 1849 | ..... | 26 | ..... | 1879 | ..... | 21 | ..... |
| 1850 | ..... | 17 | ..... | 1880 | ..... | 13 | ..... |
| 1851 | ..... | 6 | ..... | 1881 | ..... | 23 | ..... |
| 1852 | ..... | 27 | ..... | 1882 | ..... | 20 | ..... |
| 1853 | * | ..... | ..... | 1883 | ..... | ..... | 12 |
| 1854 | ..... | 14 | ..... | 1884 | ..... | 24 | ..... |
| 1855 | 25 | ..... | ..... | 1885 | ..... | 1 | ..... |
| 1856 | 8 | ..... | ..... | 1886 | ..... | 13 | ..... |
| 1857 | ..... | ..... | ..... | 1887 | ..... | 16 | ..... |
| 1858 | 7 | ..... | ..... | 1888 | ..... | 18 | ..... |
| 1859 | ..... | ..... | ..... | 1889 | ..... | 20 | ..... |
| 1860 | 13 | ..... | ..... | 1890 | ..... | 17 | ..... |
| 1861 | ..... | ..... | 24 | 1891 | ..... | ..... | ..... |

* 14, 21, 25.

TABLE XXII.—*Temperature for months of August and September.*

| Stations. | Monthly mean. | | Mean maximum. | | Mean minimum. | | Maximum. | | | | Minimum. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | August. | | September. | | August. | | September. | |
| | August. | September. | August. | September. | August. | September. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. |
| | ° | ° | ° | ° | ° | ° | | | | | | | | |
| Aberdeen, Miss | 77.2 | 72.4 | 87.9 | 83.5 | 66.5 | 61.4 | 100 | 1885 | 99 | 1887 | 44 | 1891 | 40 | 1889 |
| Allendale, S. C | 79.1 | 75.5 | 88.9 | 84.5 | 69.3 | 66.5 | 102 | 1883 | 95 | 1887 | 54 | 1884 | 41 | 1887, 1888 |
| Atlanta, Ga | 70.3 | 71.1 | 84.3 | 78.8 | 68.4 | 63.4 | 96 | 1881, 1888 | 95 | 1887 | 55 | 1887, 1891 | 43 | 1888 |
| Auburn, Ala | 78.1 | 74.0 | 86.8 | 82.7 | 69.4 | 65.4 | 98 | 1886 | 95 | 1887 | 53 | 1891 | 47 | 1888 |
| Augusta, Ga | 80.2 | 70.4 | 89.3 | 84.6 | 71.0 | 66.1 | 105 | 1878 | 98 | 1887 | 58 | 1888 | 41 | 1888 |
| Batesville, Miss | 79.0 | 73.6 | 89.9 | 84.3 | 68.2 | 63.0 | 102 | 1885 | 99 | 1884 | 49 | 1891 | 44 | 1889, 1891 |
| Branchville, S. C | 78.8 | 74.0 | 88.4 | 83.6 | 69.1 | 64.3 | 98 | 1887 | 95 | 1887 | 54 | 1888 | 35 | 1887 |
| Brookhaven, Miss | 79.7 | 75.6 | 91.5 | 88.0 | 68.0 | 63.3 | 99 | 1888, 1891 | 98 | 1889, 1891 | 47 | 1891 | 42 | 1889 |
| Brownsville, Tex | 83.1 | 79.7 | 91.3 | 87.6 | 74.9 | 71.9 | 101 | 1877, 1883 | 96 | {1877, 78, {'79, '83, '84} | 64 | 1891 | 55 | 1890 |
| Cedar Keys, Fla | 81.8 | 79.5 | 87.9 | 86.1 | 75.6 | 72.9 | 96 | 1883 | 94 | 1881 | 69 | 1881, 86, '89 | 55 | 1888 |
| Charleston, S. C | 80.8 | 76.1 | 87.0 | 82.2 | 74.5 | 70.0 | 98 | 1887 | 94 | 1876 | 62 | 1879 | 50 | 1888 |
| Cheraw, S. C | 73.2 | 72.5 | 88.7 | 82.9 | 67.6 | 62.1 | 108 | 1887 | 102 | 1883 | 52 | 1885 | 52 | 1890 |
| Chester, S. C | 78.9 | 73.5 | 89.4 | 84.0 | 68.3 | 63.0 | 101 | 1886, 1887 | 101 | 1887 | 53 | 1887 | 37 | 1888 |
| Chattanooga, Tenn | 76.7 | 71.2 | 85.6 | 80.3 | 67.8 | 62.0 | 100 | 1881 | 96 | 1881 | 54 | 1891 | 38 | 1888 |
| Columbus, Miss | 81.1 | 75.6 | 94.0 | 88.4 | 68.2 | 62.9 | 107 | 1891 | 105 | 1887 | 51 | 1887, 1891 | 43 | 1887 |
| Corinth, Miss | 78.5 | 72.8 | 89.8 | 84.2 | 67.2 | 61.4 | 102 | 1888 | 98 | 1884 | 45 | 1884 | 38 | 1888 |
| Coushatta, La | 81.2 | 75.7 | 93.0 | 87.6 | 69.4 | 63.8 | 103 | 1883 | 98 | 1883, 1884 | 46 | 1891 | 44 | 1888 |
| Charlotte, N. C | 76.4 | 71.3 | 85.2 | 79.9 | 67.6 | 62.6 | 101 | 1881 | 94 | 1881, 1887 | 53 | 1887 | 38 | 1888 |
| Devall Bluff, Ark | 76.8 | 71.2 | 88.9 | 84.0 | 64.8 | 58.5 | 104 | 1884 | 100 | 1887 | 49 | 1891 | 38 | 1883, 1885 |
| Edwards, Miss | 81.4 | 76.5 | 91.5 | 87.3 | 71.3 | 65.6 | 99 | 1887 | 98 | 1884 | 51 | 1891 | 48 | 1889 |
| El Paso, Tex | 80.8 | 73.6 | 94.4 | 86.7 | 67.2 | 60.4 | 110.2 | 1884 | 104 | 1879 | 52 | 1880 | 42 | 1889 |
| Fort Davis, Tex | 73.8 | 68.2 | 83.3 | 79.6 | 62.3 | 56.8 | 100 | 1884 | 94 | 1883 | 47 | 1882 | 37 | 1883 |
| Florence, S. C | 79.2 | 73.5 | 89.6 | 83.7 | 68.7 | 63.2 | 101 | 1883 | 97 | 1883 | 54 | 1887 | 38 | 1887 |
| Fort Elliott, Tex | 76.2 | 69.4 | 87.8 | 81.9 | 64.6 | 56.9 | 104 | 1888 | 98 | 1881 | 48 | 1880, 1882 | 37 | 1880 |
| Fort Smith, Ark | 79.0 | 73.4 | 89.9 | 84.5 | 68.3 | 62.3 | 104 | 1886 | 99.9 | 1884 | 45 | 1891 | 39.6 | 1883 |
| Galveston, Tex | 83.5 | 79.3 | 88.7 | 84.1 | 78.2 | 74.4 | 98.5 | 1874 | 94 | 1875, 1876 | 68 | 1891 | 56 | 1890 |
| Hardeeville, S. C | 80.1 | 75.6 | 90.1 | 85.1 | 70.1 | 66.2 | 100 | 1883, '87, '88 | 98 | 1887 | 50 | 1888 | 42 | 1887 |
| Hatteras, N. C | 77.8 | 74.1 | 81.9 | 78.8 | 72.7 | 69.4 | 92 | 1881, 1883 | 90 | 1881 | 60 | 1879 | 50 | 1888 |
| Hernando, Miss | 77.6 | 72.4 | 89.1 | 83.9 | 66.1 | 60.9 | 103 | 1883, 1885 | 101 | 1883 | 47 | 1883 | 43 | 1886 |
| Jackson, Miss | 80.2 | 75.4 | 91.5 | 87.2 | 68.2 | 63.6 | 100 | 1884 | 99 | 1883 | 50 | 1891 | 44 | 1889 |
| Jacksonboro, S. C | 78.7 | 73.9 | 89.2 | 84.6 | 68.1 | 63.1 | 99 | 1887 | 98 | 1887 | 45 | 1887 | 36 | 1887 |
| Jacksonville, Fla | 81.7 | 78.3 | 89.7 | 85.6 | 73.7 | 71.0 | 100 | 1874 | 98 | 1875 | 64 | 1889, 1890 | 55 | 1887, 1888 |
| Kingston, S. C | 77.9 | 72.4 | 89.2 | 83.6 | 66.5 | 61.2 | 99 | 1883, 1888 | 98 | 1890 | 43 | 1886 | 34 | 1887 |
| Kittyhawk, N. C | 76.0 | 73.7 | 80.1 | 79.1 | 72.0 | 68.3 | 102 | 1888 | 97 | 1888 | 58 | 1888 | 39 | 1888 |
| Knoxville, Tenn | 75.4 | 69.9 | 85.0 | 79.9 | 65.8 | 59.8 | 100 | 1881 | 97 | 1881 | 50 | 1879 | 35 | 1888 |
| Lake, Miss | 78.9 | 74.9 | 90.7 | 86.5 | 67.2 | 63.4 | 100 | 1886 | 100 | 1887 | 46 | 1891 | 40 | 1889 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Rock, Ark | 79.1 | 73.3 | 88.1 | 82.2 | 70.0 | 64.4 | 102 | 1881 | 97 | 1881, 1887 | 52 | 1891 | 47 | 1881 |
| Macon, Miss | 79.9 | 75.1 | 91.8 | 88.3 | 67.9 | 61.8 | 102 | 1885 | 101 | 1883 | 50 | 1884 | 40 | 1885, '89, '90 |
| Malvern, Ark | 78.6 | 72.8 | 91.4 | 85.6 | 65.8 | 59.9 | 105 | 1883, 1885 | 100 | 1887 | 37 | 1887 | 30 | 1887 |
| Memphis, Tenn | 79.0 | 72.4 | 87.6 | 81.2 | 70.4 | 63.6 | 102 | 1874 | 99 | 1887 | 53 | 1891 | 44 | 1875 |
| Mobile, Ala | 80.7 | 74.8 | 88.2 | 85.7 | 73.2 | 63.9 | 100 | 1874 | 96 | 1881, 1887 | 57 | 1891 | 52 | 1888 |
| Monroe, La | 80.4 | 75.4 | 90.7 | 85.8 | 70.0 | 64.9 | 100 | 1886 | 97 | 1883, 1887 | 54 | 1891 | 46 | 1883 |
| Montgomery, Ala | 80.2 | 76.0 | 88.6 | 85.3 | 71.7 | 66.7 | 103 | 1874 | 99 | 1887 | 58 | 1891 | 46 | 1888 |
| Nashville, Tenn | 77.8 | 70.3 | 86.8 | 79.7 | 67.7 | 60.6 | 101 | 1874 | 99 | 1887 | 51 | 1891 | 38 | 1888 |
| Natchitoches, La | 79.7 | 74.6 | 90.5 | 84.3 | 69.0 | 64.9 | 98 | 1885, '88, '89 | 96 | 1889 | 46 | 1891 | 33 | 1883 |
| New Orleans, La | 81.8 | 78.5 | 88.2 | 84.8 | 75.4 | 72.1 | 96 | 1877 | 94 | 1887, 1889 | 63 | 1891 | 56 | 1888, 1890 |
| Okolona, Miss | 80.7 | 74.8 | 93.0 | 88.2 | 68.4 | 61.4 | 106 | 1885 | 104 | 1887 | 48 | 1891 | 32 | 1887 |
| Palestine, Tex | 81.3 | 75.5 | 91.3 | 85.2 | 71.3 | 65.9 | 100 | 1887 | 95.5 | 1883 | 62 | 1884, 1887 | 47 | 1890 |
| Pensacola, Fla | 80.9 | 77.7 | 87.6 | 84.6 | 74.2 | 70.9 | 96 | 1886 | 94 | 1884, 1887 | 62 | 1891 | 54 | 1888, '89, '90 |
| Prescott, Ark | 79.4 | 73.9 | 90.1 | 82.4 | 68.7 | 63.5 | 102 | 1883, '85, '86 | 96 | 1884, 1886 | 43 | 1884 | 38 | 1885 |
| Rio Grande City, Tex | 86.3 | 81.6 | 98.0 | 92.1 | 74.6 | 71.1 | 112 | 1877 | 107 | 1877 | 59 | 1881 | 52 | 1890 |
| Savannah, Ga | 79.1 | 76.0 | 87.8 | 82.9 | 70.4 | 69.0 | 100 | 1878 | 96 | 1876, 1877 | 63 | 1879, 1890 | 48 | 1888 |
| San Antonio, Tex | 82.6 | 77.2 | 93.2 | 86.7 | 72.0 | 67.7 | 108 | 1877 | 100 | 1877 | 57 | 1891 | 50 | 1887 |
| Shreveport, La | 82.4 | 75.7 | 92.4 | 85.2 | 72.3 | 66.2 | 105 | 1881 | 101 | 1881 | 54 | 1891 | 47 | 1881 |
| Spartanburg, S. C | 76.7 | 72.0 | 87.6 | 83.0 | 65.8 | 60.9 | 98 | 1883, 1885 | 97 | 1883 | 50 | 1887, 1890 | 36 | 1887 |
| St. Matthews, S. C | 79.2 | 73.9 | 83.2 | 83.6 | 70.1 | 64.1 | 100 | 1883, 1888 | 101 | 1887 | 56 | 1886 | 39 | 1887 |
| St. Georges, S. C | 75.9 | 73.8 | 89.6 | 84.3 | 68.2 | 63.4 | 100 | 1886, 1888 | 96 | 1886 | 54 | 1888 | 38 | 1888 |
| Texarkana, Ark | 80.1 | 75.5 | 92.5 | 88.5 | 67.7 | 62.5 | 111 | 1886 | 99 | 1886, 1887 | 40 | 1886 | 44 | 1886 |
| Vicksburg, Miss | 80.9 | 75.4 | 90.2 | 84.3 | 71.6 | 66.4 | 100 | 1878 | 98 | 1881 | 54 | 1891 | 48 | 1871 |
| Wilmington, N. C | 78.4 | 73.5 | 85.9 | 81.1 | 70.9 | 65.8 | 99 | 1878 | 96 | 1872 | 56 | 1874, 1887 | 42 | 1887 |

Table XXII, temperatures for the months of August and September, is furnished at this place to show how uniform the climate is during the flowering and fiber-developing periods of the cotton. The normal temperature for the month of August is but little different from that given for June and July, and the temperature for September is but a few degrees lower. Thus we see we have four months of practically uniform climate, so far as heat is concerned, and these results are all the more interesting when taken in connection with plant growth. At this season of the year, when buds are being formed and the fruit is developing with all its tender functions, uniform degrees of heat are absolutely demanded. This is particularly true in regard to the cotton plant, when it is well known that any sudden changes in the atmospheric conditions will cause the squares to shed, the leaves to drop off, and even young bolls to die, and thus greatly reduce the yield of the crop.

The more one studies this important question of the effects of climatic changes on plant economy the more he becomes convinced that an All-wise Husbandman has specially prepared this Southern land for the cultivation of the valuable staple with which the nations of the earth are clothed.

TABLE XXIII.—*Normal data for monthly precipitation during autumn, at stations in the cotton-belt region.*

| Stations. | Precipitation for September. | Precipitation for October. | Precipitation for November. | Autumn precipitation. |
|---|---|---|---|---|
| | *Inches.* | *Inches.* | *Inches.* | *Inches.* |
| Charlotte, N. C | 3.24 | 3.65 | 3.09 | 9.98 |
| Hatteras, N. C | 6.61 | 6.52 | 5.32 | 18.45 |
| Kittyhawk, N. C | 5.18 | 4.08 | 4.16 | 13.42 |
| Wilmington, N. C | 6.70 | 4.09 | 2.55 | 13.34 |
| Charleston, S. C | 6.06 | 4.36 | 3.19 | 13.61 |
| Atlanta, Ga | 4.21 | 2.88 | 3.97 | 11.06 |
| Augusta, Ga | 3.74 | 2.65 | 3.19 | 8.58 |
| Savannah, Ga | 5.89 | 3.73 | 2.18 | 11.80 |
| Cedar Keys, Fla | 5.37 | 2.81 | 2.67 | 10.85 |
| Jacksonville, Fla | 8.06 | 5.62 | 2.56 | 16.24 |
| Pensacola, Fla | 5.25 | 3.46 | 4.34 | 13.05 |
| Chattanooga, Tenn | 4.24 | 3.10 | 4.33 | 11.67 |
| Knoxville, Tenn | 3.06 | 3.08 | 4.08 | 10.22 |
| Memphis, Tenn | 3.23 | 3.13 | 4.80 | 11.16 |
| Nashville, Tenn | 3.83 | 2.65 | 4.05 | 10.53 |
| Auburn, Ala | 3.29 | 2.48 | 4.49 | 10.26 |
| Mobile, Ala | 5.06 | 2.89 | 4.31 | 12.26 |
| Montgomery, Ala | 3.11 | 2.54 | 3.53 | 9.18 |
| Vicksburg, Miss | 3.85 | 2.89 | 5.10 | 11.84 |
| Little Rock, Ark | 3.23 | 2.48 | 5.53 | 11.24 |
| Fort Smith, Ark | 3.61 | 2.84 | 4.06 | 10.51 |
| New Orleans, La | 4.82 | 3.37 | 4.40 | 12.59 |
| Shreveport, La | 4.25 | 3.36 | 4.84 | 12.45 |
| Brownsville, Tex | 7.73 | 3.90 | 2.11 | 13.74 |
| El Paso, Tex | 1.22 | 1.15 | 0.55 | 2.92 |
| Fort Davis, Tex | 2.90 | 1.65 | 0.56 | 5.13 |
| Fort Elliott, Tex | 1.77 | 2.64 | 0.59 | 6.00 |
| Galveston, Tex | 7.07 | 4.77 | 4.56 | 16.40 |
| Indianola, Tex | 7.01 | 3.71 | 3.06 | 13.78 |
| Palestine, Tex | 3.21 | 3.44 | 4.53 | 11.18 |
| Rio Grande City, Tex | 3.78 | 2.22 | 0.89 | 6.89 |
| San Antonio, Tex | 4.16 | 1.82 | 2.00 | 7.98 |
| Corsicana, Tex | 3.09 | 2.35 | 3.44 | 8.88 |

Table XXIII, precipitation at stations over the cotton region, shows remarkably uniform results at all points, with the excep-

tion of some stations located in the western part of Texas and on the Atlantic and Gulf coasts. The experience of the writer, extending over a number of years of practical observation of changes of the weather and on the cultivation of the cotton, has convinced him that autumn is not a wet period in the South, and that floods during this season of the year are very rare. It is therefore particularly a suitable time for the white, delicate fiber of the cotton to protrude beyond the carpels of the bolls, and not run the risk of becoming stained by continued precipitation or a long period of cloudy weather.

At the beginning of October, under the influence of cool nights, with the general reduction of temperature during the day, the bolls have about all matured that will produce good grades of cotton. It is not often that undergrown bolls, the latter part of October, will develop good fiber unless the season of mild weather is unusually prolonged into December. This condition of the climate has occurred several times within the past twenty or twenty-five years, and the cotton crops those years were very large.

Table XXIV, temperatures for October and November, shows uniform reduction in the normals of 10° to 12° from those given in the table for August and September, but at no place throughout the belt, excepting at extreme northern points, is the reduction in October so great as to endanger the life of the plant. This statement is true where normals are concerned, but when we examine the records year after year we will find it necessary to modify our assertion somewhat. At nearly all stations north of Augusta, Ga., and Montgomery, Ala., some years give several days in October that produce frosts. For instance, at Augusta, Ga., the thermometer reached below 35° four Octobers in a period of nineteen years. But the minimum temperature during this time reached the frost point only twice, viz., in 1873 and in 1891. In the case of the mean minimum temperature we find that fifteen years gave results above 50°. In the case of Charleston, S. C., not much farther south, only once during the twenty years of record did the temperature go below 40°, and that was in 1873, when the thermometer registered 39°; ten years it was 45° and above; the mean minimum ranged between 55° and 66°. To bring this case out more clearly let us take one more station, viz., Vicksburg, Miss., a town in the west and some distance inland. Here the minimum temperature reached below 35°, but above 30°, only once during a period of nineteen years, this was in 1873, when the thermometer recorded as low as 31°. The remaining eighteen years the minimum temperature was above 38°. At no time did the mean minimum temperature fall below 50°.

According to charts very carefully made from the records of 100 stations over the Southern States, the normal time of frost for October 15 passes as far north as Kittyhawk, Charlotte, Chattanooga,

Nashville, Cairo, Dodge City, and Fort Elliott. While the frost line for November passes through Charleston, Atlanta, Starksville, Vicksburg, and Palestine. We may safely assert, therefore, that usually there will be good picking season, as far as the temperature is concerned, until November 1. At intervals in the South the season favorable for gathering the crop extends far into the winter, and one year, in the recollection of the writer, the planters were picking as late as the middle of December. These occasions, however, are rare, and it is almost universally the case that the heavy frosts in November put a stop to all cotton picking.

## VIII.—COMMENTS ON YEARS OF GOOD AND POOR CROPS.

As a conclusion to the subject of the climatology of the cotton plant I have prepared Table XXV, showing yield of cotton in each state, with the climatic conditions. Two years, 1878 and 1879, are years of good crops, and the other two years, 1884 and 1886, are years of small and poor crops. If the season has been unpropitious in the quantity of rain during the months of May and June, and part of July, and a season of rains, with a good per cent. of sunshine, should continue through August, a fine crop may be assured, provided September and October are dry. But if June, July, and August are very dry and hot, and September and October are wet, the crop will be greatly cut off.

At the close of the years 1878 and 1879 the farmers in the South gathered large crops of cotton in an average fair condition. An analysis of the table will satisfactorily explain the reasons for these large yields. In 1878 the rains in June and July were not excessive, except in Alabama, Mississippi, and Louisiana. In August the deficiency of June and July was brought up, and in September and October, during the picking season, the weather was generally dry. The season for maturing the fiber and picking was excellent. The rains in Alabama, Mississippi, and Louisiana encouraged the multiplication of insects and rust so that the average yield per acre was materially cut off in those States. The percentage of clear days was large throughout the year, and although moisture was amply sufficient for the growing crop, the sunshine was materially beneficial in opening the bolls and drying out the fiber. With the exception of June the temperature was high—several degrees above the normal—thus adding another important factor to the advantage of the cotton. The crop was larger than the great one of 1877.

The spring and summer of 1879 were not so favorable as they were in 1878, because of the general deficiency of rain in June, and the low temperature in June, August, and September. The drought in the spring and nearly half of the summer prevailed over the entire South. The timely rains that came the latter part of July and con-

tinued through August encouraged a rapid development in the growth of the plant; and the few rainy days with the large percentage of clear days in September and October caused the fruit to ripen rapidly, and the increasing warmth of October caused the bolls to open and prevented staining and decaying of the fiber. The excellent season for picking extended into December and thus greatly increased the yield of the crop.

There were great spring floods throughout the South in 1884, and also in 1886, and the crops were badly damaged by the heavy rains with the small percentage of sunshine during the month of June. The temperature was also generally below the normal throughout the entire summer. The plant was thus greatly retarded in its growth and a large loss was sustained in the shedding of the forms and the rotting of the bolls. The autumn in each year was more favorable than was the weather in spring and summer, and this seasonable condition did much to make amends for the disasters in spring and summer. The fiber was gathered in 1886 in an unstained condition and there was a minimum amount of dirt and trash in the cotton gathered. The maturing season was so unfavorable the vitality of the plant was greatly reduced, and but for the excellent soils and good tillage in some portions of the belt the cotton crops for the years 1884 and 1886 would have been much smaller than reported.

## IX.—DISCUSSION OF TEMPERATURE CHARTS.

These charts have been prepared for this work to bring out more clearly the fact already referred to several times in these pages, viz., the summer temperature is very uniform throughout the cotton belt.

In preparing the charts the stations in extreme western and southwestern Texas have been omitted because they are outside of what has been assumed as the cotton region. The high maxima in July, recorded for the middle section of the belt, are unusual extremes that occurred at only one station in 1881, Montgomery, Ala., and at one station in 1887, Kittyhawk, N. C., within periods of nineteen and seventeen years. In 1881, at all stations the maxima were 92°, 96°, 102°, 103°, 100°, and 105°. In 1887 the maxima were 104°, 95°, 98°, 104°, 100°, 89°, 100°, and 102°.

These charts are of special interest in showing clearly the uniform temperature for the three months of summer. In June the mean temperature ranges between 81° and 76°, in July between 83° and 78.5°, and in August between 81.5° and 78.5°.

These charts also bring out the other important fact, already mentioned in this work, that the mean maxima and mean minima are never great extremes, and may be repeated from year to year while the highest range of maximum may occur only once in a period of ten years. It is proper, therefore, to carefully study these mean

maxima and mean minima in connection with the study of plant growth, rather than lay special stress on low and high extremes that occur so seldom in such long periods of years. In the southern section of the cotton belt the mean maximum, during the twelve years under consideration, varied only 4° in June, 4° in July, and 3° in August. The mean minimum for June varied only 3.5°; for July, 3°, and for August, 3°.

During the winter months these two factors give much greater variations, for reasons that are not necessary to discuss in this work

TABLE XXIV.—*Temperature for months of October and November.*

| Stations. | Monthly mean. | | Mean maximum. | | Mean minimum. | | Maximum. | | | | Minimum. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | October. | | November. | | October. | | November. | |
| | October. | November. | October. | November. | October. | November. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. |
| | ° | ° | ° | ° | ° | ° | | | | | | | | |
| Aberdeen, Miss | 62.0 | ..... | 74.0 | ..... | 50.0 | ..... | 95 | 1883 | ..... | ..... | 26 | 1890 | ..... | ..... |
| Allendale, S. C | 65.6 | ..... | 76.5 | ..... | 54.7 | ..... | 95 | 1884 | ..... | ..... | 30 | 1884 | ..... | ..... |
| Atlanta, Ga | 62.0 | 51.9 | 70.5 | 60.4 | 53.6 | 43.4 | 91 | 1884 | 82 | 1890 | 30 | 1887 | 16 | 1887 |
| Auburn, Ala | 64.0 | 53.8 | 74.7 | 63.8 | 53.4 | 43.7 | 94 | 1884 | 81 | 1882 | 31 | 1891 | 12 | 1891 |
| Augusta, Ga | 64.8 | 55 | 75.2 | 65.4 | 54.4 | 44.6 | 94 | 1884 | 85 | 1885 | 29 | 1873 | 24 | 1873, '87, '89 |
| Batesville, Miss | 62.2 | ..... | 74.4 | ..... | 50.1 | ..... | 97 | 1884 | ..... | ..... | 28 | 1884 | ..... | ..... |
| Branchville, S. C | 63.4 | ..... | 74.8 | ..... | 52.0 | ..... | 95 | 1884 | ..... | ..... | 30 | 1891 | ..... | ..... |
| Brookhaven, Miss | 68.4 | ..... | 79.3 | ..... | 52.5 | ..... | 95 | 1883, '84 | ..... | ..... | 28 | 1886, '87 | ..... | ..... |
| Brownsville, Tex | 70.1 | 66.8 | 83.8 | 74.9 | 66.4 | 58.6 | 95 | 1877 | 89 | 1882 | 49 | 1879, '89 | 30 | 1880 |
| Cedar Keys, Fla | 72.6 | 63.5 | 79.2 | 70.6 | 66 | 56.4 | 89 | 1881, '84 | 81 | 1881, '82, '86 | 39 | 1887 | 27 | 1887 |
| Charleston, S. C | 67.2 | 58.3 | 74.1 | 65.6 | 60.2 | 50.9 | 93 | 1883 | 82 | 1879 | 39 | 1873 | 28 | 1873, '81, '87 |
| Cheraw, S. C | 61.9 | ..... | 74.2 | ..... | 49.6 | ..... | 96 | 1884 | ..... | ..... | 28 | 1891 | ..... | ..... |
| Chester, S. C | 62.7 | ..... | 74.1 | ..... | 51.3 | ..... | 95 | 1884 | ..... | ..... | 30 | 1887, '89, '91 | ..... | ..... |
| Chattanooga, Tenn | 61.6 | 50.5 | 71.1 | 59.6 | 52.1 | 41.4 | 91 | 1884 | 79 | 1879, '90 | 32 | 1889 | 16 | 1889 |
| Columbus, Miss | 64.5 | ..... | 77.5 | ..... | 55.1 | ..... | 98 | 1883 | ..... | ..... | 30 | 1884 | ..... | ..... |
| Corinth, Miss | 62.6 | ..... | 75.4 | ..... | 49.9 | ..... | 97 | 1884 | ..... | ..... | 22 | 1884 | ..... | ..... |
| Coushatta, La | 65.0 | ..... | 77.9 | ..... | 52.0 | ..... | 94 | 1883 | ..... | ..... | 28 | 1887 | ..... | ..... |
| Charlotte, N. C | 64.6 | 50.7 | 71.3 | 60 | 51.8 | 41.4 | 92 | 1884 | 80 | 1879 | 30 | 1879 | 18 | 1880 |
| Devall Bluff, Ark | 61.5 | ..... | 75.9 | ..... | 47.2 | ..... | 92 | 1884 | ..... | ..... | 20 | 1889 | ..... | ..... |
| Edwards, Miss | 65.8 | ..... | 77.0 | ..... | 54.5 | ..... | 94 | 1883, '84 | ..... | ..... | 31 | 1887 | ..... | ..... |
| El Paso, Tex | 63.8 | 51.2 | 78.2 | 64.9 | 49.4 | 37.6 | 94 | 1879, '87 | 82 | 1882 | 28 | 1882 | 11 | 1880 |
| Fort Davis, Tex | 61.9 | 50.6 | 74.0 | 62.8 | 49.7 | 38.3 | 90 | 1881 | 82 | 1885 | 30 | 1880 | 6 | 1880 |
| Fort Elliott, Tex | 58.1 | 43.5 | 70.3 | 56.3 | 45.9 | 30.8 | 94 | 1889 | 84 | 1888 | 25 | 1887 | — 5 | 1880, '87 |
| Fort Smith, Ark | 62.8 | 50.6 | 74.5 | 61.4 | 51.1 | 39.8 | 94.6 | 1884 | 86 | 1882 | 31 | 1886 | 19 | 1891 |
| Galveston, Tex | 72.6 | 62.3 | 77.6 | 67.6 | 67.5 | 57 | 89 | 1890 | 85 | 1886 | 45 | 1873 | 29 | 1880 |
| Hardeeville, S. C | 65.9 | ..... | 77.1 | ..... | 54.8 | ..... | 96 | 1884 | ..... | ..... | 30 | 1884 | ..... | ..... |
| Hatteras, N. C | 65.1 | 56.1 | 70.2 | 61.7 | 60 | 50.4 | 90 | 1881 | 79 | 1882 | 42 | 1876, '80, '87 | 28 | 1879 |
| Hernando, Miss | 61.4 | ..... | 73.3 | ..... | 49.6 | ..... | 97 | 1884 | ..... | ..... | 24 | 1886 | ..... | ..... |
| Jackson, Miss | 65.2 | ..... | 77.3 | ..... | 53.2 | ..... | 97 | 1883 | ..... | ..... | 30 | 1891 | ..... | ..... |
| Jacksonboro, S. C | 69.5 | ..... | 75.9 | ..... | 53.0 | ..... | 99 | 1884 | ..... | ..... | 27 | 1886 | ..... | ..... |
| Jacksonville, Fla | 70.5 | 62.5 | 78.3 | 71.1 | 62.8 | 53.8 | 92 | 1883, '84 | 86 | 1889 | 40 | 1873, '87 | 26 | 1887 |
| Kingstree, S. C | 62.7 | ..... | 75.3 | ..... | 50.1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Kittyhawk, N. C | 64.1 | 53.9 | 69.6 | 56.9 | 58.6 | 47.9 | 90 | 1881 | 80 | 1888 | 38 | 1876 | 23 | 1879 |
| Knoxville, Tenn | 58.8 | 47.8 | 69.5 | 57.4 | 48.1 | 38.2 | 94 | 1884 | 81 | 1881 | 25 | 1876 | 12 | 1872 |
| Lake, Miss | 63.5 | ..... | 76.5 | ..... | 50.5 | ..... | 98 | 1883 | ..... | ..... | 28 | 1884, '91 | ..... | ..... |
| Little Rock, Ark | 63.7 | 51.3 | 73 | 60.1 | 54.3 | 42.5 | 90 | 1881, '83 | 83 | 1882 | 33 | 1886, '87 | 0 | 1887 |
| Macon, Miss | 64.3 | ..... | 77.6 | ..... | 51.0 | ..... | 99 | 1883 | ..... | ..... | 28 | 1887 | ..... | ..... |
| Malvern, Ark | 69.6 | ..... | 85.9 | ..... | 53.7 | ..... | 94 | 1883 | ..... | ..... | 27 | 1885 | ..... | ..... |

TABLE XXIV.—*Temperature for months of October and November*—Continued.

| Stations. | Monthly mean. | | Mean maximum. | | Mean minimum. | | Maximum. | | | | Minimum. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | October. | | November. | | October. | | November. | |
| | October. | November. | October. | November. | October. | November. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. | Degrees. | Year. |
| | ° | ° | ° | ° | ° | ° | | | | | | | | |
| Memphis, Tenn | 62.7 | 50.9 | 71.3 | 59 | 54 | 42.8 | 92 | 1879, '84 | 82 | 1879 | 29 | 1878 | 16 | 1877, '80 |
| Mobile, Ala | 68.2 | 58.5 | 77 | 67.4 | 59.3 | 49.6 | 93 | 1884 | 83 | 1888 | 34 | 1873, '87 | 25 | 1887 |
| Monroe, La | 65.2 | ..... | 76.6 | ..... | 53.8 | ..... | 93 | 1883 | ..... | ..... | 32 | 1886 | ..... | ..... |
| Montgomery, Ala | 65.5 | 55.6 | 75.5 | 65.3 | 55.6 | 45.9 | 96 | 1884 | 83 | 1879, '82 | 32 | 1887 | 21 | 1872 |
| Nashville, Tenn | 60.3 | 48.8 | 70.3 | 57.8 | 50.3 | 39.8 | 92 | 1884 | 81 | 1882 | 27 | 1887 | 10 | 1887 |
| Natchitoches, La | 64.5 | ..... | 76.9 | ..... | 52.1 | ..... | 95 | 1883 | ..... | ..... | 32 | 1886, '91 | ..... | ..... |
| New Orleans, La | 70.4 | 61.0 | 77.3 | 68.1 | 63.4 | 53.9 | 90 | 1884, '89 | 85 | 1885, '88 | 40 | 1873 | 30 | 1891 |
| Okolona, Miss | 63.6 | ..... | 77.4 | ..... | 49.8 | ..... | 99 | 1883 | ..... | ..... | 27 | 1884 | ..... | ..... |
| Palestine, Tex | 66.8 | 56.5 | 77.1 | 66.1 | 56.4 | 46.9 | 94 | 1883 | 87 | 1888 | 37 | 1888 | 20 | 1887 |
| Pensacola, Fla | 67.8 | 59.4 | 75.6 | 67.6 | 62.1 | 51.2 | 95 | 1884 | 81 | 1882, '88 | 38 | 1887 | 28 | 1881, '87 |
| Prescott, Ark | 62.2 | ..... | 73.8 | ..... | 50.5 | ..... | 92 | 1884 | ..... | ..... | 23 | 1884 | ..... | ..... |
| Rio Grande City, Tex | 74.5 | 64.9 | 85.2 | 74.9 | 63.7 | 54.9 | 105 | 1877 | 98 | 1877 | 41 | 1891 | 30 | 1880, '83 |
| Savannah, Ga | 66.9 | 58.6 | 74.7 | 67.3 | 59.1 | 49.9 | 92 | 1883, '84 | 83 | 1889 | 37 | 1873 | 22 | 1872 |
| San Antonio, Tex | 69.5 | 58.3 | 80.1 | 68.6 | 58.9 | 48.1 | 99 | 1877 | 88 | 1879, '91 | 40 | 1888 | 21 | 1880 |
| Shreveport, La | 66.4 | 55.6 | 76.6 | 65.4 | 56.2 | 45.7 | 95 | 1883 | 86 | 1882 | 31 | 1873 | 18 | 1880 |
| Spartanburg, S. C | 60.4 | ..... | 73.5 | ..... | 47.3 | ..... | 96 | 1884 | ..... | ..... | 22 | 1889 | ..... | ..... |
| Saint Matthews, S. C | 64.2 | ..... | 76 | ..... | 52.4 | ..... | 97 | 1884 | ..... | ..... | 33 | 1885 | ..... | ..... |
| Saint Georges, S. C | 63.9 | ..... | 75.6 | ..... | 52.1 | ..... | 97 | 1884 | ..... | ..... | 27 | 1884 | ..... | ..... |
| Texarkana, Ark | 63.6 | ..... | 78.3 | ..... | 48.8 | ..... | 91 | 1884 | ..... | ..... | 28 | 1891 | ..... | ..... |
| Vicksburg, Miss | 65.9 | 56.0 | 75.2 | 65.4 | 56.5 | 46.7 | 93.7 | 1884 | 85 | 1885, '89 | 34 | 1873, '87 | 22 | 1891 |
| Waynesboro, Miss | 64.9 | ..... | 78.2 | ..... | 51.5 | ..... | 90 | 1884 | ..... | ..... | 30 | 1886, '87 | ..... | ..... |
| Wilmington, N. C | 62.1 | 55.6 | 69.1 | 64.7 | 55.1 | 46.5 | 93 | 1884 | 83 | 1877 | 32 | 1876 | 20 | 1872 |

TABLE XXV.—*Exhibiting two years of good crops and two years of poor crops, with the climatic conditions controlling the yield of cotton in each State of the cotton belt.*

| States. | June. | | | | | | | July. | | | | | | | August. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. |
| 1878. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | |
| North Carolina | 3.81 | —0.97 | 71.1 | —4.3 | 36 | 43 | 57 | 3.27 | —2.74 | 79.3 | +0.5 | 24 | 32 | 68 | 8.24 | +1.83 | 78.4 | +1.2 | 56 | 49 | 51 |
| South Carolina | 4.44 | —0.33 | ..... | ..... | 37 | 50 | 50 | 8.98 | +3.18 | ..... | ..... | 55 | 42 | 58 | 8.10 | +2.14 | ..... | ..... | 42 | 45 | 55 |
| Georgia | 5.20 | —0.04 | 78.2 | 0.0 | 45 | 57 | 43 | 6.11 | +1.62 | 83.7 | +2.7 | 40 | 45 | 55 | 6.05 | +0.55 | 83.8 | +5.3 | 42 | 52 | 48 |
| Florida | ..... | ..... | ..... | ..... | 38 | ..... | ..... | ..... | ..... | ..... | ..... | 53 | ..... | ..... | ..... | ..... | ..... | ..... | 45 | ..... | ..... |
| Alabama | 6.15 | +1.35 | 79.2 | +1.4 | 37 | 53 | 47 | 3.31 | —1.06 | 84.2 | +0.3 | 37 | 52 | 48 | 7.82 | +3.82 | 82.4 | +3.5 | 44 | 45 | 55 |
| Tennessee | 4.62 | —0.23 | 73.3 | —2.7 | 43 | 50 | 50 | 5.73 | +1.51 | 82.4 | +3.2 | 40 | 39 | 61 | 4.53 | +0.98 | 80.0 | +2.8 | 34 | 39 | 61 |
| Mississippi | 7.21 | +2.06 | 78.9 | +0.1 | 50 | 50 | 50 | 3.99 | —0.63 | 83.7 | +2.4 | 23 | 36 | 64 | 4.47 | +0.56 | 82.6 | +2.4 | 42 | 39 | 61 |
| Louisiana | 7.50 | +2.59 | 80.3 | —0.5 | 45 | 49 | 53 | 6.16 | +0.90 | 83.8 | +0.5 | 48 | 39 | 64 | 3.80 | —0.03 | 80.2 | —1.9 | 48 | 36 | 64 |
| Texas | 2.43 | —0.75 | 83.3 | +2.6 | 33 | ..... | ..... | 6.79 | +3.99 | 83.9 | +0.7 | 30 | ..... | ..... | 6.34 | +3.09 | 84.1 | +1.9 | 40 | ..... | ..... |

| States. | September. | | | | | | | October. | | | | | | | Injury to crop from insects, etc. | Bales per acre. | Total number of bales. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | | | |
| 1878. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | | | |
| North Carolina | 4.06 | —1.18 | 74.4 | —1.5 | 42 | 40 | 60 | 7.91 | +3.61 | 63.5 | —0.2 | 26 | 39 | 61 | Small | 0.38 | 221,699 |
| South Carolina | 8.56 | +3.69 | ..... | ..... | 33 | 57 | 43 | 2.69 | —0.75 | ..... | ..... | 23 | 42 | 58 | ....do | 0.36 | 342,173 |
| Georgia | 8.02 | +4.27 | 75.5 | +3.0 | 38 | 57 | 43 | 1.97 | —0.79 | 66.1 | +1.5 | 25 | 39 | 61 | Bad in sections. | 0.36 | 530,703 |
| Florida | ..... | ..... | ..... | ..... | 63 | ..... | ..... | ..... | ..... | ..... | ..... | 26 | ..... | ..... | ..... | 0.24 | 39,256 |
| Alabama | 2.64 | —0.10 | 76.3 | —3.6 | 20 | 43 | 57 | 3.16 | +0.69 | 65.6 | +0.8 | 21 | 45 | 55 | Bad in sections. | 0.29 | 539,015 |
| Tennessee | 1.53 | —1.62 | 70.1 | —0.9 | 19 | 30 | 70 | 3.49 | +0.60 | 61.8 | +1.6 | 29 | 33 | 67 | Small | 0.59 | 430,190 |
| Mississippi | 2.46 | —1.65 | 75.8 | +0.4 | ..... | 37 | 63 | 3.92 | +0.83 | 66.0 | —0.3 | 29 | 36 | 64 | Bad in sections. | 0.30 | 748,952 |
| Louisiana | 2.15 | —2.28 | 76.5 | —0.6 | 32 | 33 | 67 | 3.37 | —0.03 | 68.1 | —0.3 | 29 | 33 | 67 | ....do | 0.35 | 498,851 |
| Arkansas | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 0.61 | 707,282 |
| Texas | 4.76 | —0.96 | 78.9 | —1.8 | 22 | ..... | ..... | 1.71 | —2.14 | 73.9 | +2.0 | 21 | ..... | ..... | Small | 0.61 | 1,105,133 |
| Total | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5,169,314 |

TABLE XXV.—*Exhibiting two years of good crops and two years of poor crops, &c.*—Continued.

| States. | June. | | | | | | | July. | | | | | | | August. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. |
| 1879. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | |
| North Carolina | 2.37 | —2.41 | 73.4 | —2.0 | 28 | 33 | 67 | 5.54 | —0.47 | 78.1 | —0.7 | 34 | 45 | 55 | 8.02 | +1.61 | 75.7 | —1.5 | 51 | 49 | 51 |
| South Carolina | 2.58 | —2.19 | ..... | ..... | 23 | 40 | 60 | 7.63 | +1.83 | ..... | ..... | 26 | 42 | 58 | 5.71 | —0.25 | ..... | ..... | 39 | 55 | 45 |
| Georgia | 3.42 | —1.82 | 77.8 | —0.2 | 21 | 43 | 57 | 5.51 | +0.52 | 82.1 | +0.9 | 31 | 42 | 58 | 4.87 | —0.63 | 77.4 | —1.1 | 36 | 61 | 39 |
| Florida | ..... | ..... | ..... | ..... | 37 | ..... | ..... | ..... | ..... | ..... | ..... | 40 | ..... | ..... | ..... | ..... | ..... | ..... | 48 | ..... | ..... |
| Alabama | 2.97 | —1.83 | 75.9 | —1.9 | 43 | 40 | 60 | 5.10 | +0.70 | 81.1 | —2.8 | 55 | 52 | 48 | 4.93 | +0.92 | 75.6 | —3.3 | 47 | 48 | 52 |
| Tennessee | 2.55 | —2.30 | 75.8 | —0.2 | 28 | 43 | 57 | 4.92 | +0.70 | 82.0 | +2.8 | 37 | 45 | 55 | 4.03 | +0.42 | 74.4 | —2.8 | 31 | 45 | 55 |
| Mississippi | 2.96 | —2.19 | 78.9 | +0.1 | 27 | 37 | 63 | 4.36 | —0.26 | 83.2 | +1.9 | 29 | 45 | 55 | 6.50 | +2.59 | 77.9 | —2.3 | 39 | 45 | 55 |
| Louisiana | 2.53 | —2.38 | 80.7 | —0.1 | 22 | 33 | 67 | 4.73 | —0.53 | 83.8 | +0.5 | 34 | 45 | 55 | 7.60 | +3.77 | 80.0 | —2.1 | 18 | 42 | 58 |
| Arkansas | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 23 | ..... | ..... | ..... | ..... | ..... | ..... | 32 | ..... | ..... |
| Texas | 2.28 | —0.90 | 79.4 | —1.3 | 23 | ..... | ..... | 1.60 | —1.20 | 84.9 | +1.7 | 19 | ..... | ..... | 6.91 | +3.66 | 81.9 | —0.3 | 23 | ..... | ..... |

| States. | September. | | | | | | | October. | | | | | | | Bales per acre. | Total number of bales. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | | |
| 1879. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | | |
| North Carolina | 5.68 | +0.44 | 70.0 | —5.9 | 28 | 40 | 60 | 2.79 | —1.51 | 66.8 | +3.1 | 23 | 45 | 55 | 0.35 | 216,978 |
| South Carolina | 3.63 | —1.24 | ..... | ..... | 30 | 37 | 63 | 3.48 | +0.03 | ..... | ..... | 35 | 52 | 48 | 0.32 | 300,173 |
| Georgia | 3.81 | +0.06 | 72.2 | —0.3 | 16 | 40 | 60 | 4.02 | +1.26 | 67.9 | +3.3 | 35 | 61 | 39 | 0.35 | 551,893 |
| Florida | ..... | ..... | ..... | ..... | 66 | ..... | ..... | ..... | ..... | ..... | ..... | 58 | ..... | ..... | 0.23 | 37,707 |
| Alabama | 1.44 | —1.30 | 70.9 | —9.0 | 23 | 30 | 70 | 6.65 | +4.18 | 66.4 | +1.6 | 47 | 58 | 42 | 0.38 | 715,020 |
| Tennessee | 2.01 | —1.14 | 68.4 | —2.6 | 18 | 22 | 78 | 2.48 | —0.41 | 65.1 | +1.7 | 27 | 39 | 61 | 0.59 | 454,349 |
| Mississippi | 2.89 | —1.22 | 74.0 | —1.4 | 17 | 30 | 70 | 1.35 | —1.78 | 68.7 | +2.4 | 16 | 35 | 64 | 0.41 | 849,400 |
| Louisiana | 2.05 | —2.38 | 76.6 | —0.5 | 15 | 30 | 70 | 0.94 | —2.46 | 70.4 | +2.0 | 24 | 42 | 58 | 0.45 | 593,431 |
| Arkansas | ..... | ..... | ..... | ..... | 3 | ..... | ..... | ..... | ..... | ..... | ..... | 16 | ..... | ..... | 0.61 | 719,583 |
| Texas | 6.34 | +0.62 | 78.7 | +1.6 | 18 | ..... | ..... | 2.19 | —1.66 | 72.2 | +0.3 | 19 | ..... | ..... | 0.39 | 752,500 |
| Total | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5,191,034 |

TABLE XXV.—*Exhibiting two years of good crops and two years of poor crops, &c.*—Continued.

| States. | June. | | | | | | | July. | | | | | | | August. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. |
| 1884. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | |
| North Carolina | 6.12 | +1.34 | 71.8 | −2.6 | 40 | 50 | 50 | 9.37 | +3.36 | 78.0 | −0.8 | 47 | 45 | 55 | 6.03 | −0.38 | 76.1 | −1.1 | 35 | 52 | 48 |
| South Carolina | 6.72 | +1.95 | 74.2 | −3.8 | 50 | 67 | 33 | 6.34 | +0.54 | 80.8 | −1.4 | 36 | 45 | 55 | 8.09 | +2.13 | 78.1 | +0.3 | 48 | 45 | 55 |
| Georgia | 8.15 | +2.91 | 78.0 | −0.2 | 50 | 60 | 40 | 3.12 | −1.37 | 80.4 | −0.6 | 32 | 39 | 61 | 4.74 | −0.76 | 77.6 | −0.9 | 38 | 39 | 61 |
| Florida | 7.14 | +1.38 | 77.2 | −3.0 | 50 | ..... | ..... | 6.94 | +1.70 | 82.0 | −0.1 | 55 | ..... | ..... | 5.13 | −1.12 | 80.4 | −1.1 | 54 | ..... | ..... |
| Alabama | 8.82 | +4.02 | 74.6 | −3.2 | 57 | 57 | 43 | 4.18 | −0.22 | 79.4 | −4.5 | 44 | 42 | 58 | 2.25 | −1.76 | 77.2 | −1.7 | 23 | 36 | 64 |
| Tennessee | 6.37 | +1.52 | 73.0 | −3.0 | 57 | 60 | 40 | 4.72 | +0.50 | 77.8 | −1.4 | 48 | 49 | 51 | 2.94 | −0.67 | 75.2 | −2.0 | 23 | 39 | 61 |
| Mississippi | 4.92 | −0.23 | 77.4 | −1.4 | 47 | 45 | 55 | 4.78 | +0.16 | 83.4 | +2.1 | 27 | 36 | 64 | 1.31 | −2.60 | 79.8 | −0.4 | 16 | 29 | 71 |
| Louisiana | 6.41 | +1.50 | 79.4 | −1.4 | 47 | 43 | 57 | 2.09 | −3.15 | 85.8 | +2.5 | 23 | 36 | 64 | 1.43 | −2.40 | 81.5 | −0.6 | 19 | 33 | 67 |
| Arkansas | 2.30 | −2.03 | 75.6 | 0.0 | 20 | ..... | ..... | 5.11 | +1.12 | 81.5 | +0.8 | 29 | ..... | ..... | 3.50 | −0.29 | 76.8 | −2.0 | 24 | ..... | ..... |
| Texas | 4.77 | +1.59 | 77.6 | −3.1 | 22 | ..... | ..... | 0.69 | −2.11 | 82.8 | −0.4 | 6 | ..... | ..... | 2.23 | −1.02 | 81.0 | −1.2 | 13 | ..... | ..... |

| States. | September. | | | | | | | October. | | | | | | | Bales per acre. | Total number of bales. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | | |
| 1884. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | | |
| North Carolina | 3.52 | −1.72 | 74.5 | −1.4 | 13 | 30 | 70 | 1.15 | −3.15 | 67.3 | +3.6 | 13 | 29 | 71 | 0.38 | 398,200 |
| South Carolina | 4.40 | −0.47 | 74.7 | +2.1 | 16 | 33 | 67 | 0.12 | −3.33 | 68.9 | +3.4 | 13 | 23 | 77 | 0.29 | 469,600 |
| Georgia | 2.96 | −0.79 | 75.9 | +3.4 | 20 | 23 | 77 | 1.27 | −1.49 | 69.7 | +5.1 | 12 | 20 | 80 | 0.26 | 752,500 |
| Florida | 4.71 | −2.65 | 79.2 | +0.7 | 32 | ..... | ..... | 2.23 | −3.60 | 73.6 | +3.3 | 17 | ..... | ..... | 0.23 | 58,900 |
| Alabama | 1.45 | −1.29 | 75.2 | −4.7 | 12 | 23 | 77 | 3.02 | +0.55 | 69.5 | +4.7 | 15 | 22 | 78 | 0.24 | 630,400 |
| Tennessee | 2.44 | −0.71 | 74.2 | +3.2 | 18 | 40 | 60 | 2.44 | −0.45 | 65.6 | +2.2 | 16 | 29 | 71 | 0.38 | 310,700 |
| Mississippi | 2.50 | −1.61 | 78.8 | +3.4 | 28 | 33 | 67 | 0.99 | −2.14 | 70.0 | +3.7 | 23 | 29 | 71 | 0.40 | 901,300 |
| Louisiana | 2.61 | −1.82 | 80.5 | +3.4 | 27 | 30 | 70 | 3.07 | −0.33 | 71.2 | +2.8 | 24 | 33 | 67 | 0.53 | 490,200 |
| Arkansas | 5.02 | +1.66 | 77.0 | +3.6 | 30 | ..... | ..... | 1.31 | −1.51 | 64.9 | +1.0 | 11 | ..... | ..... | 0.44 | 518,500 |
| Texas | 5.21 | −0.21 | 79.1 | +2.0 | 32 | ..... | ..... | 7.52 | +3.67 | 68.6 | −3.3 | 36 | ..... | ..... | 0.37 | 1,118,000 |
| Total | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5,648,300 |

TABLE XXV.—*Exhibiting two years of good crops and two years of poor crops, &c.*—Continued.

| States. | June. | | | | | | | July. | | | | | | | August. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. |
| 1886. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | |
| North Carolina | 8.58 | +3.80 | 72.7 | —2.7 | 53 | 60 | 40 | 9.86 | +3.85 | 77.1 | —1.7 | 42 | 45 | 55 | 6.95 | +0.54 | 75.6 | —1.6 | 50 | 58 | 42 |
| South Carolina | 10.16 | +5.39 | 77.1 | —0.9 | 57 | 67 | 33 | 6.02 | +1.22 | 79.8 | —2.4 | 42 | 48 | 52 | 1.42 | —4.54 | 78.8 | +1.0 | 38 | 55 | 45 |
| Georgia | 8.52 | +3.28 | 78.4 | +0.2 | 50 | 60 | 40 | 5.54 | +1.05 | 78.1 | —2.9 | 45 | 42 | 58 | 4.02 | —1.48 | 77.9 | —0.6 | 36 | 48 | 52 |
| Florida | 6.75 | +0.99 | 80.5 | +0.3 | 47 | ..... | ..... | 11.85 | +6.67 | 80.5 | —1.6 | 71 | ..... | ..... | 7.38 | +1.13 | 80.7 | —0.8 | 45 | ..... | ..... |
| Alabama | 5.56 | +0.76 | 75.8 | —2.0 | 60 | 60 | 40 | 3.68 | —0.72 | 77.6 | —6.3 | 39 | 39 | 61 | 3.38 | —0.63 | 78.6 | —0.3 | 36 | 45 | 55 |
| Tennessee | 6.79 | +1.94 | 72.7 | —3.3 | 48 | 63 | 37 | 4.56 | +0.34 | 76.4 | —2.8 | 29 | 33 | 67 | 5.72 | +2.11 | 76.2 | —1.0 | 40 | 51 | 49 |
| Mississippi | 9.50 | +4.35 | 76.8 | —2.0 | 60 | 53 | 47 | 2.37 | —2.25 | 79.9 | —1.4 | 33 | 33 | 67 | 3.22 | —0.69 | 80.2 | 0.0 | 37 | 36 | 64 |
| Louisiana | 6.73 | +1.82 | 78.7 | —2.1 | 55 | 53 | 47 | 3.47 | —1.79 | 80.7 | —2.6 | 45 | 39 | 61 | 3.00 | —0.83 | 81.7 | —0.4 | 29 | 22 | 78 |
| Arkansas | 7.69 | +3.36 | 74.2 | —1.4 | 50 | ..... | ..... | 2.80 | —1.19 | 79.4 | —1.3 | 36 | ..... | ..... | 3.57 | —0.22 | 79.1 | +0.4 | 26 | ..... | ..... |
| Texas | 4.66 | +1.48 | 77.8 | —2.9 | 30 | ..... | ..... | 2.46 | —0.34 | 80.8 | —2.4 | 29 | ..... | ..... | 2.75 | —0.50 | 81.1 | —1.1 | 20 | ..... | ..... |

| States. | September. | | | | | | | October. | | | | | | | Bales per acre. | Total number of bales. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent of clear days. | Precipitation. | Precipitation departure. | Mean temperature. | Temperature departure. | Per cent. of rainy days. | Per cent. of cloudy days. | Per cent. of clear days. | | |
| 1886. | *Inches.* | *Inches.* | ° | ° | | | | *Inches.* | *Inches.* | ° | ° | | | | | |
| North Carolina | 2.01 | —3.23 | 73.6 | —2.3 | 16 | 40 | 60 | 0.45 | —3.85 | 63.4 | —0.3 | 1 | 23 | 77 | 0.38 | 407,230 |
| South Carolina | 2.06 | —2.81 | 75.3 | +2.7 | 20 | 40 | 60 | 0.59 | —2.86 | 62.5 | —3.0 | 1 | 23 | 77 | 0.32 | 554,652 |
| Georgia | 0.94 | —2.81 | 74.9 | +2.4 | 20 | 37 | 63 | 0.36 | —2.40 | 63.4 | —0.2 | 13 | 21 | 79 | 0.32 | 900,025 |
| Florida | 2.53 | —4.83 | 79.0 | +0.5 | 37 | ..... | ..... | 1.73 | —4.10 | 69.7 | —0.6 | 19 | ..... | ..... | 0.27 | 73,837 |
| Alabama | 1.44 | —1.30 | 75.5 | —4.4 | 13 | 37 | 63 | 0.36 | —2.11 | 64.3 | —0.5 | 3 | 22 | 78 | 0.27 | 760,447 |
| Tennessee | 3.92 | +0.77 | 71.6 | +0.6 | 23 | 37 | 63 | 0.66 | —2.23 | 59.6 | —3.8 | 13 | 22 | 78 | 0.37 | 321,638 |
| Mississippi | 5.52 | +1.41 | 76.0 | +0.6 | 37 | 40 | 60 | 0.48 | —2.65 | 65.7 | —0.6 | 10 | 19 | 81 | 0.40 | 1,019,470 |
| Louisiana | 4.54 | +0.11 | 77.4 | +0.3 | 39 | 40 | 60 | 1.91 | —1.49 | 67.1 | —1.3 | 10 | 19 | 81 | 0.49 | 487,722 |
| Arkansas | 5.23 | +1.87 | 73.8 | +0.5 | 30 | ..... | ..... | 1.30 | —1.52 | 61.6 | —2.3 | 13 | ..... | ..... | 0.45 | 610,666 |
| Texas | 13.78 | +8.06 | 77.9 | +0.8 | 50 | ..... | ..... | 2.02 | —1.83 | 67.3 | —4.6 | 13 | ..... | ..... | 0.38 | 1,332,027 |
| Total | | | | | | | | | | | | | | | | 6,527,714 |

CHART I.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the winter months along the northern limits of the cotton belt.*

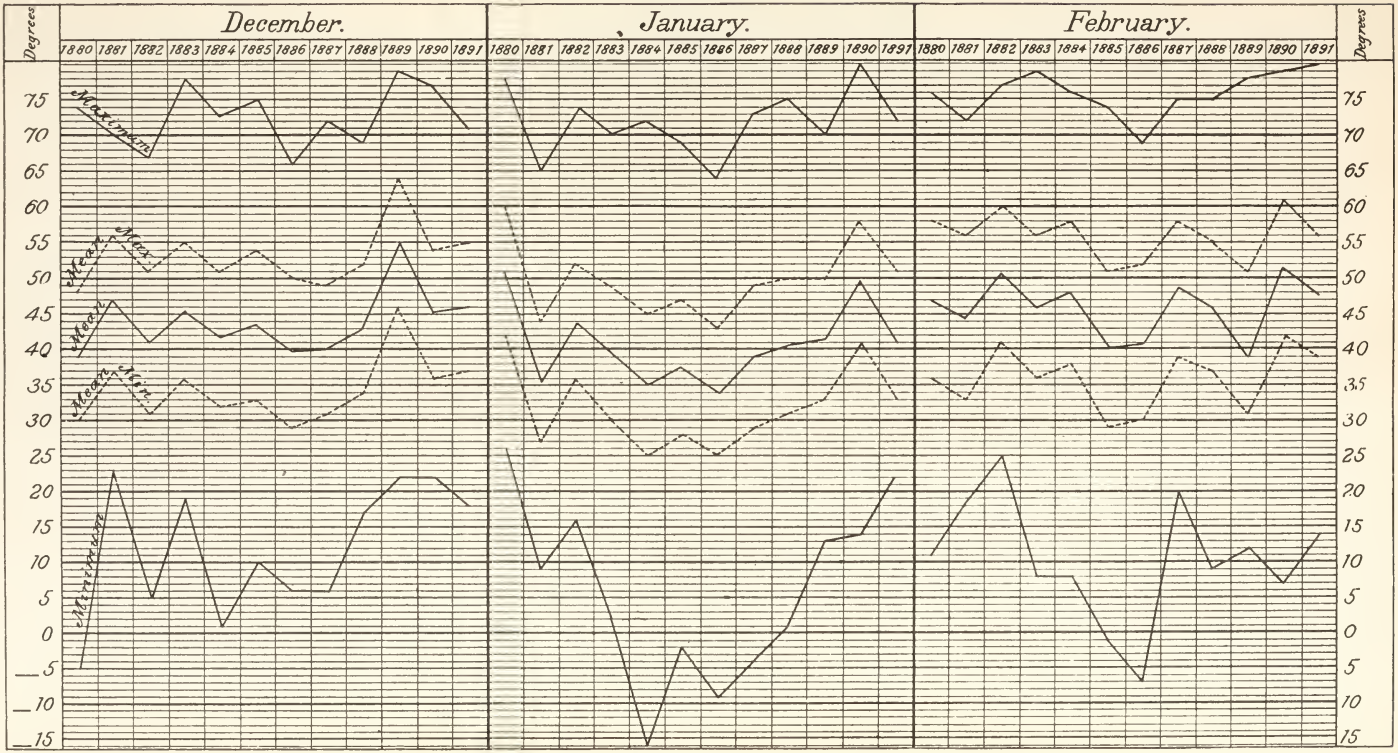

CHART II.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the summer months along the northern portions of the cotton belt.*

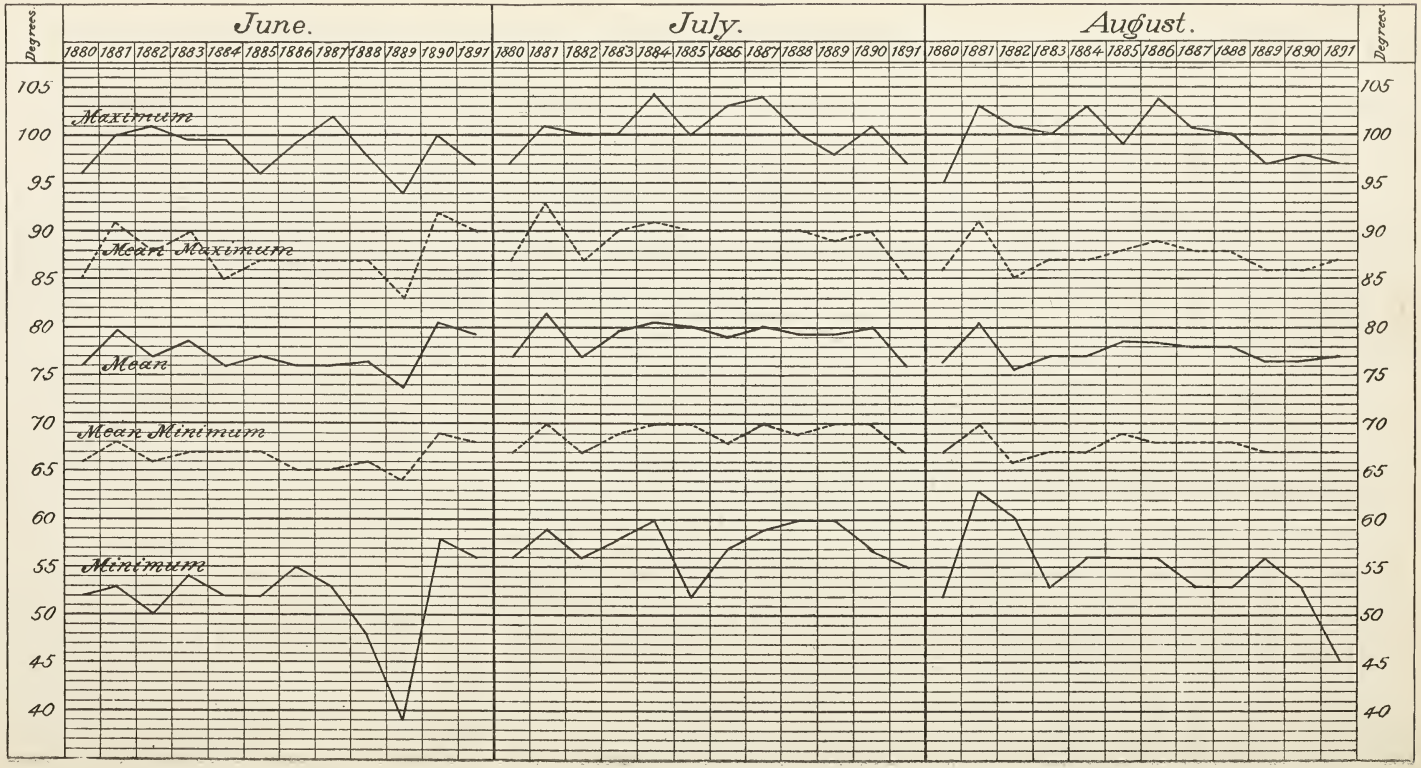

CHART III.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the winter months along the middle portions of the cotton belt.*

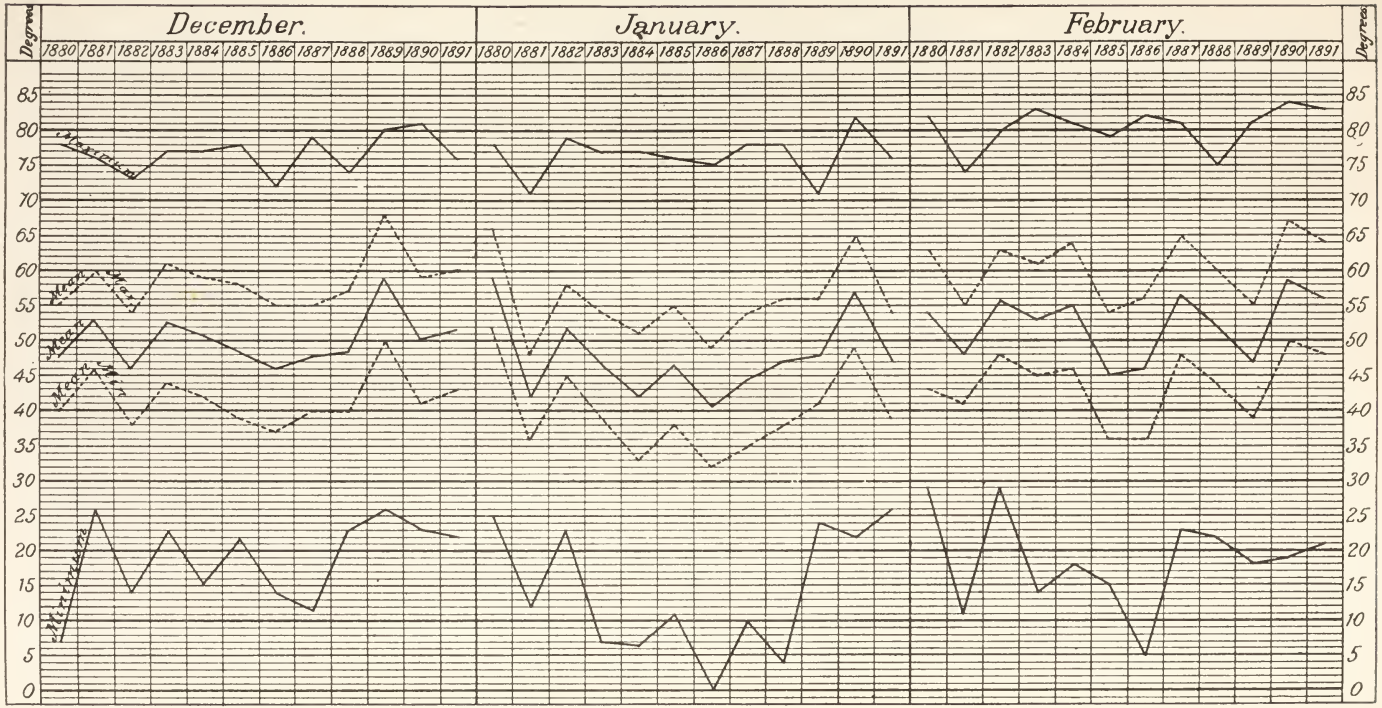

CHART IV.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the summer months along the middle portions of the cotton belt.*

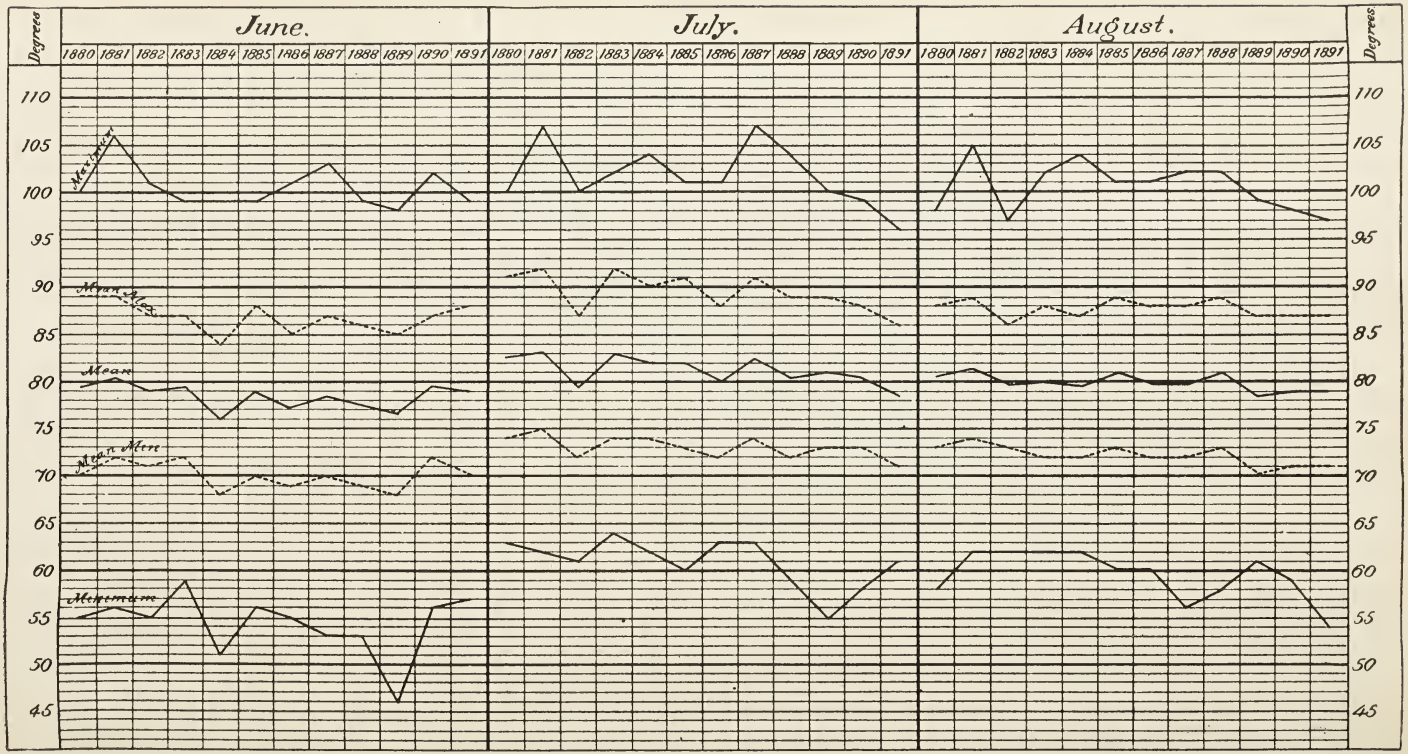

CHART V.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the winter months over the southern regions of the cotton belt.*

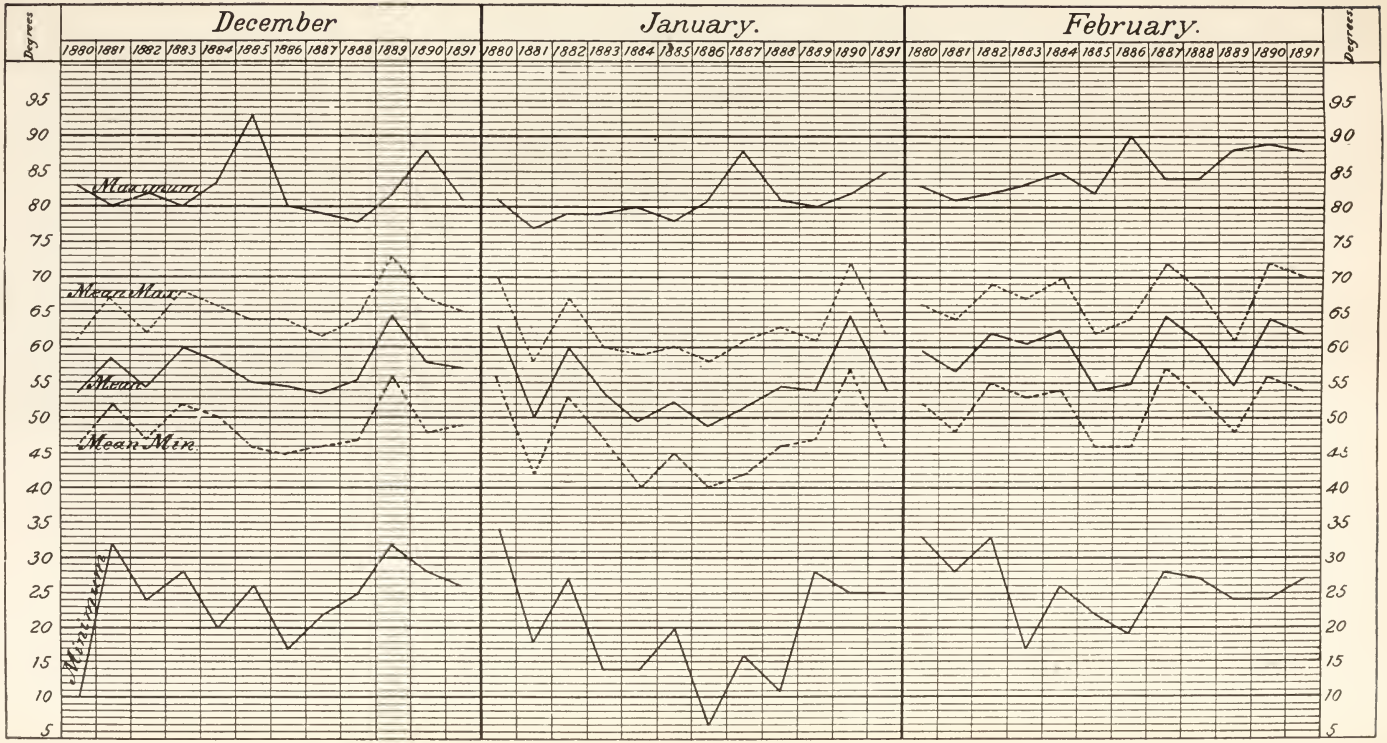

CHART VI.—*Mean temperature, mean maximum, mean minimum, maximum and minimum for the summer months along the southern regions of the cotton belt.*

CHART VII—MAP OF THE COTTON PRODUCING STATES, SHOWING IN EACH SECTION THE RELATIONS BETWEEN THE AREA CULTIVATED IN COTTON AND THE TOTAL AREA.